JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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SYSTEM OF HEATING AND LIGHTING BY GAS, P. P. I. E.
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ELECTRICITY AND MATTER.
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PRESERVATION OF POLES AND PILES.

A BANK LIGHTING INSTALLATION.

NEW AND PROPOSED REGULATIONS AFFECTING WATER POWER DEVELOPMENT.
BY L. F. HARZA.

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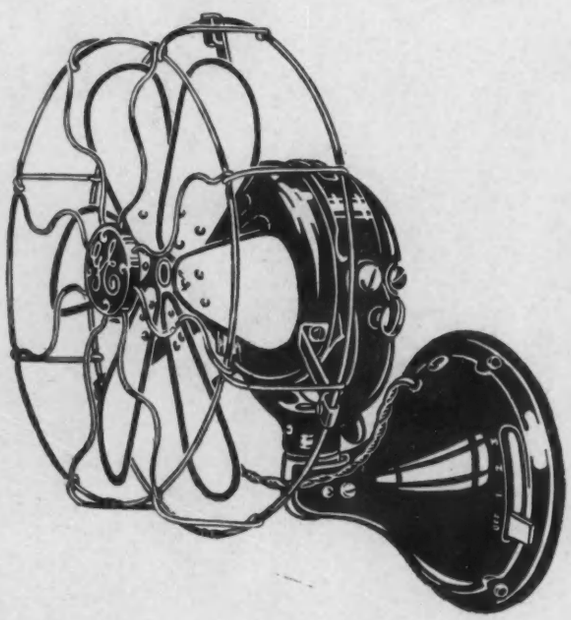

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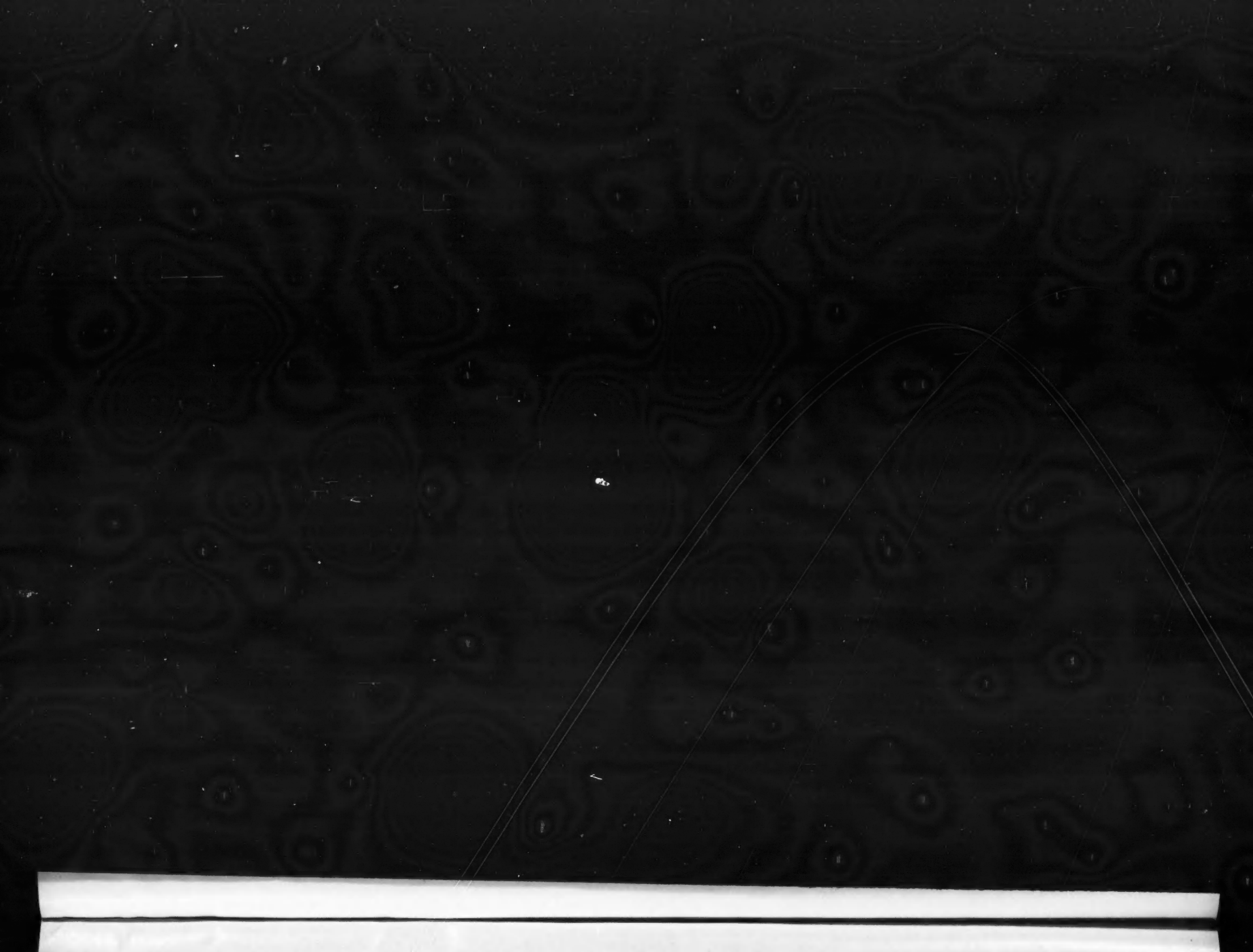

MAR 25 1914

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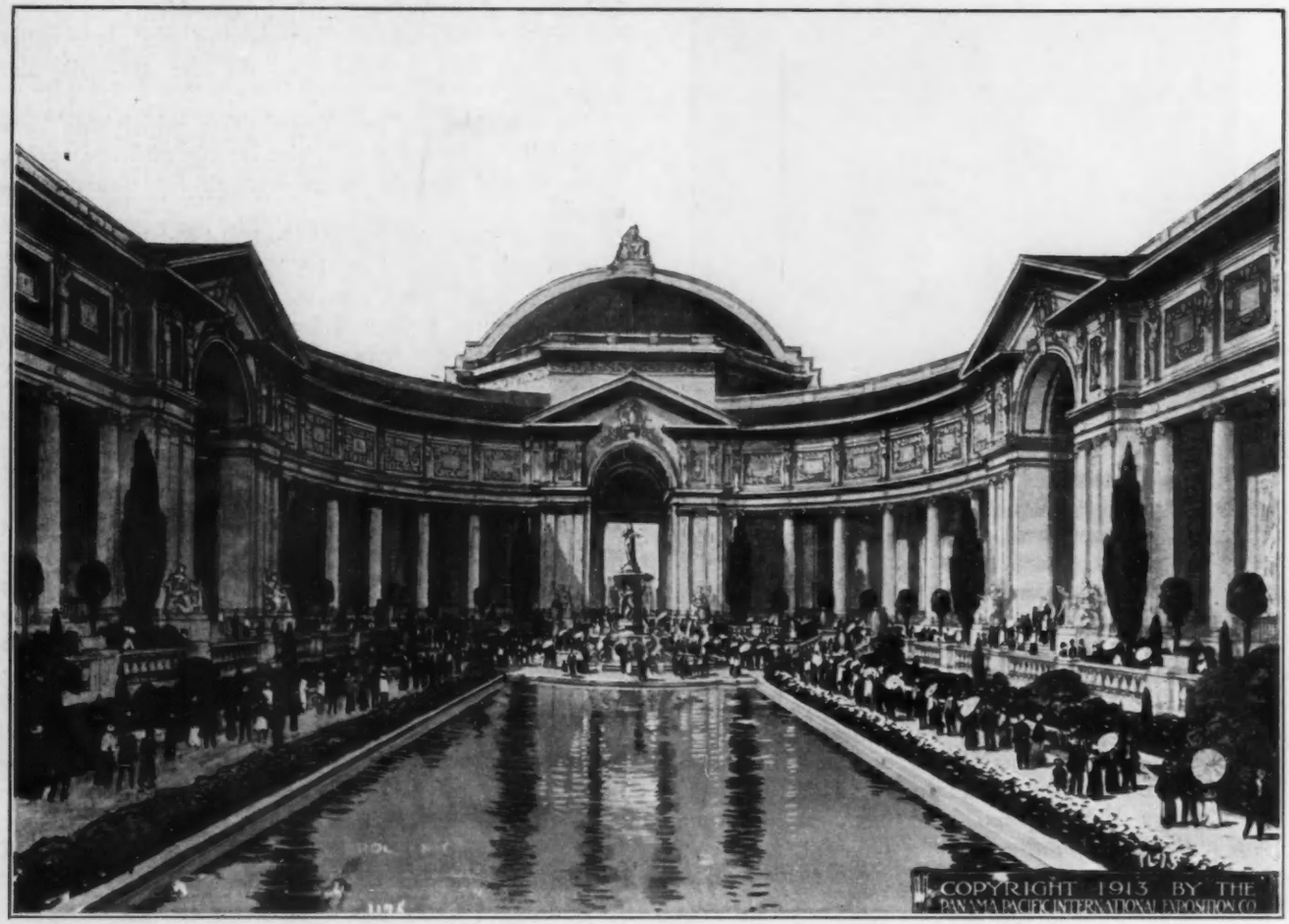


The Court of Palms at the P. P. I. E. Gas Will Be an Important Factor in Its Illumination.

SYSTEM OF HEATING AND LIGHTING BY GAS — P. P. I. E.

BY GUY R. KINSLEY.

(There is described in this article the system of gas distribution to be used at the Panama-Pacific International Exposition, San Francisco 1915, and the extent to which gas will be used for street and ornamental lighting and for heating purposes, in connection with which a new system is mentioned.—The Editors.)

Gas is to be an important and versatile factor in the success of the Panama-Pacific International Exposition. Gas will share with Old Sol, who smiles perennially on San Francisco, and with the matured descendants of the modest electricity that Franklin lured to stay in New England, the glory of "enlightening" the world to its progress; to gas also falls the duty of driving the chill from the great buildings at night and feeding at any hour the hungry mouths that may crave any food from hot bouillon to a table d'hote dinner; added to these will be its part in the spectacular lighting effects that are to transform the various courts at night.

And then, as if these functions were not sufficient to employ one agency, gas will literally and figuratively "blaze" the way for the coming decade's progress in the science of heating and lighting and several tributary fields. The exposition is to be a

pathfinder for the latest inventions in these lines and for 10 months the grounds will be a vast experiment ground and station for the observation of world experts. And when this period is ended success or failure of the experiments will be emblazoned to every clime on the globe where civilization may bend a listening ear and turn a watchful eye.

The very system by which the 635 acres of ground are piped for the demands that are to be made in 1915 is a testimonial to the great advance that has been made in a branch of the gas distribution science that was almost unknown at the time of the Louisiana Purchase Exposition in 1904.

Part of the Court of the Universe.

St. Louis gas engineers engaged in solving the exposition's problem of gas supply at that time found the exposition removed from the center of gas distribution which placed them at a disadvantage for they had no large gas feeders. They depended on a low gas delivery under pressure from the St. Louis mains.

Since 1904 there have been rapid strides in the development of high pressure gas distribution both for direct service and for boosting or reinforcing low pressure systems. The Panama-Pacific International Exposition grounds are fortunately situated as far as gas delivery is concerned by being located directly on a high power loop extending from the gas works at the south end of the city almost around San Francisco to the North Beach holder station.

This loop is a 16 in. steel main and its approach to the North Beach is through Webster street, which is almost the spine of the exhibition grounds. From this 16 in. main is taken an eight in. steel loop extending completely around the grounds. Another loop of four inch steel pipe circles the state and pavilion sites. The portion of the exposition grounds east of Webster street, including the amusement concessions, will be supplied from an 8 in. steel loop.

The reason for extending these gas mains in the form of loops is to avoid what is generally known as "dead ends"; these are the terminals of gas mains farthest removed from the source of supply and these "dead ends" there is naturally a reduction in pressure according to the amount of gas taken from them until in the point most remote the pressure is low and the service unsatisfactory.

This refers mainly to low pressure gas distribution but would also apply in a measure to high pressure distribution. Experience of past expositions has proven the disadvantages of both low pressure and "dead ends."

By laying gas mains in loops returning to the source of supply equalizes the pressure and provides a system where the circuit of gas is perfect and the pressure uniform. Low pressure distribution is always considered as that force which is exerted on the gas by the weight of the gas holder or by rotary boosting fans and the pressure is measured in terms of inches of water in a syphon pressure gauge. Low pressure is commonly used for lighting, heating and cooking and the pressure is from four to six inches or about one-seventh to one-fifth of a pound per sq. in. This was the pressure of gas given other expositions that utilized gas on the grounds and buildings.

A requisite for low distribution which has been lacking in past systems is the laying of large mains. They should also be large enough for unusual demands.

All of these defects are obviated by the high pressure system installed at the 1915 exposition grounds. The gas is delivered into steel mains of smaller size under pressure measured by pounds per square inch and the pressure is reduced by a regulator at each consumer's meter to a pressure in inches of water necessary to give the best results for the particular purpose for which the gas is to be used.

For instance for ordinary incandescent gas light a pressure of from four to six inches is most satisfactory while for industrial uses pressure to as high as one pound may be employed with greater satisfaction and economy; and for the latest installation of high pressure power lamps for street lighting, such as are now used in London, Paris and Berlin, only, and which will be used for lighting the amusement streets at the exposition, a pressure of two pounds applied directly to the mantle gives the greatest lighting efficiency.

Another advantage of high pressure over low pressure is the ability to increase the supply of gas by increasing the initial pressure. In the low pressure systems the increase in demand can only be provided for by the installation of larger pipes or boosting the low pressure with consequent leakage of joints of cast iron mains.

And in this matter of joints and mains the system prepared by the Pacific Gas & Electric Company for the International Exposition is far in advance of any used anywhere whether in an exposition or community. The San Francisco company is the pioneer and the P. P. I. E. is the greatest demonstrator in the world of a loop system without joints. And it is a system of more than nine miles of pipe within the fence that encloses the world enterprise.

All the steel tubes are welded together by the oxy-acetylene torch using rods of Norway iron for the welding material. These welds are actually stronger than any other section of the great steel pipe and the mains when finished consist of an endless welded tube without leaks. They are tested for leaks under a pressure of 100 lb. per sq. in, and when they have proved to be tight under this pressure they will be absolutely tight under the working pressure of 40

lb. per sq. in., maximum, which will be supplied to the exposition.

The compressors are not capable of greater pressure on the exposition mains and the average pressure will be nearer 30 lb. On Geary street, San Francisco, the first strip of welded steel pipe ever laid for high pressure was installed but a comparatively short time since, and the exposition test will be of great value in further demonstrating the advantages of the new plan.

In the matter of measuring the gas supply for the exposition two of the latest meters will be used and scientific men will be able to watch this invention in an unusual test. Two Thomas electric gas meters will be used to record the flow of high pressure gas. The gas that passes through the meter is heated by means of an electric current and a careful measurement of the quantity of electricity employed and the rise in temperature of the gas, taken with the known specific gravity of oil gas supplies the factor for determining the exact quantity of gas used.

The gas that will be used is made from the California crude petroleum by a process which is itself Californian. It is produced from the oil with practically no by-products as is the case where coal gas is made. The gas is remarkably free from sulphur and other impurities. Its illuminating power is about 19 c.p. and it has a heat capacity always in excess of 600 B.t.u. per cu. ft. It is expected to provide an ideal fuel for heating, cooking, illuminating and all other purposes within the fair grounds coupled with convenience and safety which are not enjoyed when solids or liquid fuels are used.

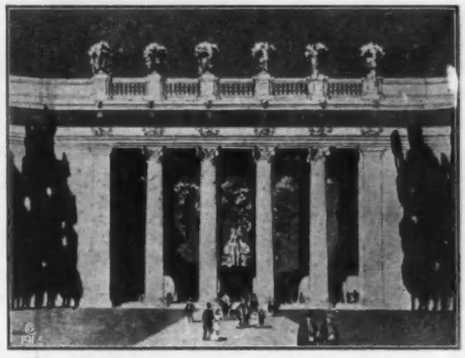
A part of the exposition lighting system will in fact be an exhibition of high pressure gas lamps to be used here in this country for the first time. They will be placed in the section of the grounds occupied by the state and foreign pavilions and on the concession streets. They will stand on a bronze upright and will be attractive even when not lighted.

In the Court of Abundance gas will have its greatest part in the spectacular features of the exposition. The theme is the creation and development of the earth and the history of man in symbol will be presented. Here the high pressure gas will be used in great flaring flambeau surrounding the lagoon in the center and lined against the fire-proof walls of the court. By the use of minerals distributed in the gas varied colors will be created which will cast their spell on the splendor of the scene.

Important to the exposition and to the scientific world as these uses of gas are to be its use in heating promises to excel all other. "Surface combustion" is something new in the scientific world and has never been given extensive use but if the plans of the exposition are consummated this development of the use of gas will be given a complete test which will advertise its merits to the world as no other means could do. "Surface combustion" is the use of heat from gas without flame. The distinguishing and essential feature of this process is that a homogeneous explosive mixture of gas and air, in the proper proportions for complete combustion, is caused to burn without flame in contact with a granular incandescent solid, whereby a large proportion of the potential energy of the gas is immediately converted into radiant form.

The advantages of the new system which the exposition test would fully determine are: that the combustion is greatly accelerated by the incandescent surface and may be concentrated where the heat is desired; the combustion is perfect with a minimum excess of air; high temperatures are possible without the aid of elaborate regenerative devices and as a matter of economy the originators claim for it twice the heat with half the cost.

In the heaters to be used for cooking there will be one great difference from all the stoves now designed to utilize the principle of 'surface combustion." The exposition stove will not have the fan as the mixing of the gas will be accomplished without its use due to a later idea.



Part of the Court of Four Seasons.

This will be another utility which will be in the nature of the most interesting exhibit to the gas men of the world and especially to the scientists who first conceived the idea of "surface combustion."

Gas will also be used for patrol purposes and the grounds will be so well equipped with gas lighting that a complete suspension of electric power would leave the grounds well lighted. After the closing hours for the 10 months gas will be used until daybreak.

These are the things that the exposition will do with gas and the science that has been brought from the ends of the world to get the most out of its power. The many exhibits in the great exhibit palaces relating to manufacture and the various appliances for gas consumption will add to the interest of the world's greatest exposition to the minds of men trained to gas problems and gas rewards.

An electrical marine elevator constructed and installed by the port of Seattle, achieved the remarkable record, the first day of its use, of unloading 2273 bales of hay, aggregating 126 tons, from a steamship in the short space of three hours. It was estimated that under the old system of unloading by trucking up slips or inclines that this would have constituted a full day's work. Even better results are expected when the operators have more experience with the new equipment.

ELECTRICITY AND MATTER.

BY DR. HENRY S. CARHART.

(This is a popular exposition of the subject, having been given originally by Dr. Carhart as a lecture of the Throop College Extension Course at the Y. M. C. A., Pasadena, Cal. It is at once scientific and most clearly stated. The author traces the discoveries of Crookes, Roentgen, Becquerel, Madam Curie, and others, up to the ultimate electron.—The Editors.)

I am well aware that my subject is a difficult one; it does not lend itself readily to popular exposition and illustration. But it has intrinsic attractions, for men of philosophic mind have ever inquired into the nature and constitution of matter; not of forms and organisms alone, but of the ultimate nature of the material out of which the whole physical universe is made. I say the whole physical universe advisedly, for during the past century the spectroscope has revealed to us the existence in sun and stars of the same elementary substances that are present in the earth. Indeed, the discovery of helium in the sun preceded its discovery in the earth by thirty years, thus reversing in a most remarkable manner the order of identification of terrestrial and solar elements.

Interest in the inquiry relative to the nature of matter has been enormously stimulated by the revolutionary discoveries of recent years, made through the agency of electricity. In fact, more progress in this field has been made in the last thirty-five years than in any preceding century. The point of attack has been matter in the gaseous state, and the instrumentality, the discharge of electricity in high vacua. I hope to give in a brief way some of the successive steps by which these discoveries have been made.

It is now thirty-five years since Sir William Crookes made his epochal discovery of matter in what he aptly and prophetically termed the fourth, or ultra-gaseous, or radiant state. It was my good fortune to import in 1881 a full set of the famous Crookes tubes, and later in the same year to make the acquaintance of the celebrated discoverer at the Exposition of Electricity in Paris. The value placed on Crookes' discoveries in England is indicated by his recent election to the presidency of the Royal Society, "the highest honor attainable by an English man of science."

The discovery of X rays by means of Crookes tubes was announced by Roentgen in 1895. They are produced in some mysterious manner when cathode rays are suddenly stopped, especially by heavy substances like platinum. Their most striking properties are their ability to penetrate thin metallic sheets and other opaque substances, their effect on a sensitized photographic plate, and their power of exciting fluorescence in certain salts, especially platino-cyanides. It is by means of this flourescence that we are enabled apparently to look through opaque bodies.

The activities of X rays in promoting photographic changes led directly to the discovery of the radioactivity of uranium by Becquerel in 1896. Becquerel found that uranium salts give off spontaneously radiations capable of passing through black paper and thin sheets of aluminum foil, and affecting photographic plates, as X rays do. These radiations are not modified in any way by the most drastic physical treatment of the uranium, whether of heat or cold or other physical changes. You know that Madam Curie in the search for other radio-active substances discovered the most remarkable element known to science; I mean radium. One of the striking properties of radium is its ability to promote the discharge of electrified bodies. This means that the radiations from radium are able to ionize the air, that is, to resolve it into parts which are carriers respectively of positive and negative charges of electricity; for gases do not conduct electricity unless they are first ionized. The charged ions then move with their charges, thus conveying a current.

It is necessary at this point to make a slight digression for the purpose of describing the composite nature of the radiations from radium and similar bodies. There are three sorts of radiations from radium, which are known as alpha, beta and gamma-rays or radiations. None of these are rays in the sense in which the word ray is used in light, with the possible exception of the gamma-rays. The beta-rays have been identified with cathode rays in a Crookes tube. They consist of minute particles carrying or composed of the same quantity of negative electricity, and they are called electrons. They are the same whatever their source, and they travel with a speed of the same order as the velocity of light.

Alpha-rays are positively charged radiations, traveling with a much smaller velocity than that of the beta-rays. They have now been definitely identified with the atom of helium. Alpha-rays have only relatively slight penetrating power and are quickly absorbed.

Gamma-rays are unchanged or electrically neutral radiations, and quite analogous to X-rays. Their penetrating power is immensely greater than that of either alpha or beta-rays. Since they are not electrically charged, they are unaffected by either electric or magnetic forces.

Even beta-rays may be resolved into many distinct groups which suffer different deflections under the influence of a magnetic field.

Some thirty years ago Aitkin made the discovery that fine dust particles serve as a nuclei for the condensation of moisture and the precipitation of rain. Sudden expansion of saturated air causes a precipitation of a fog if dust particles are present; in their absence it was concluded that the expansion and consequent cooling must be carried much further than are necessary for condensation when dust nuclei are present. But when no cloud was formed in dust-free enclosed air by sudden expansion the heating to redness of a platinum wire in the enclosure was immediately followed by condensation. The scientific men of that day, including Sir Oliver Lodge, whose brilliant experiments in Montreal I well remember, did not imagine that the hot platinum wire gave off anything but dust and invisible smoke. At that period the electron whas not even known, much less its function in ionizing the air and thus furnishing nuclei for the condensation of moisture. It has now been abundantly demonstrated that alpha, beta and gamma-rays all produce ionization of gases, and that these ions in turn condense moisture. Thus a way has been opened to make visible the track of electrons and

alpha particles. Mr. C. T. R. Wilson of England has been most ingenious in devising methods of making visible the trajectories of flying particles and even of photographing them. So now we have lantern slides to bring to the eye evidence of the presence and effects of these smallest known bodies of the physical world, these ultimate corpuscles of matter or electricity, whichever it may be.

The path of an individual alpha particle is shown by the condensation of water on the ions formed in its path, and is seen as a straight luminous trail which was photographed.

A similar effect is produced by beta-particles, but the trail is not so intense and is discontinuous, showing the condensation on individual ions, on account of the higher speed and smaller ionization of the lighter and swifter particles.

The number of ions produced in air at atmospheric pressure depends on the speed of the particles. For alpha particles it varies from 2000 to 6000 per millimeter of path, that is, between 50,000 and 150,000 per inch. The high speed beta particles in general are much less efficient ionizers; they produce not more than 20 or 30 ions per millimeter of path, that is, 500 to 750 per inch. In most cases the number of ions produced is minute compared with the number of molecules present. It is possible to detect the presence of one or two ions in a cubic centimeter per second, while the number of molecules in a cubic centimeter at standard temperature and pressure is 2.7×10^{19}.

Beta-rays you will recall consist of electrons. The electron is often called the "atom of electricity." It is probably the ultimate element out of which all matter is built, or at least, it enters into the structure of every atom of matter. Until recently the atom of hydrogen was supposed to be the smallest existing mass of matter. The atom, as the word signifies, was the ultimate mass indivisible by any known means. But the electron has a mass only 1/1800 as great as the atom of hydrogen, and all electrons are the same, whatever be their source. Thus the old "atom" of chemistry has lost forever its character as the ultimate body into which matter may be resolved. Instead of sixty or seventy elementary atoms, we now have one ultimate electron; even that may be only negative electricity, for its mass is not a constant but varies with its velocity. If its velocity approaches that of light, its mass is nearly trebled as compared with a velocity one-third that of light. Even the constancy of the mass of matter is therefore brought in question by these latest discoveries on the borderland of matter. The change of mass incident to high velocity is too infinitesimal, except in the case of high speed electrons, to affect in any appreciable degree the masses known to astronomy and the ordinary masses of physics and daily life.

The old alchemists sought in vain to transform one element into another. The raison d'etre of their research was the production of gold and not pure science. Their failure has in it a lasting lesson for men of science. Not mere commercialism, but the love of discovery must be the chief stimulus and ruling impulse in scientific work. The marvel now is that in this new century the discovery of the spontaneous transmutation of one element into others in three or four stages has put to shame the fettered imagination and the commercialized search of the alchemists.

The oxide of uranium was discovered in 1789 in the mineral pitchblende, which is now the chief source of radium. It was not until 1840, however, that metallic uranium was reduced from one of its ores. Uranium compounds are now manufactured in large quantities. They impart to glass a rich yellow-green color, which fluoresces in the light of a Geissler tube.

Uranium has the highest atomic weight of any known substance, namely, 238.5 times the atomic weight of hydrogen. It is ordinarily obtained from the mineral uranite, where it is always associated with the other radio-active substances, ionium, radium, and actinium. This association was suggestive of the transformation of an element of high atomic weight into others of successively lower atomic weight. Such has been found to be the case. Uranium is the parent of ionium,and ionium is the parent of radium. Uranium is thus the primary source from which radium is derived, and radium is a disintegration product. Further, radium gives off a gas known as radium emanation, which is also radio-active, that is, it emits alpha, beta and gamma particles. The radium atom disintegrates with the expulsion of an alpha particle, and the residue of the radium atom becomes the atom of the gaseous radium emanation. Now if this gas is sealed in a small spectrum tube and examined with a spectroscope, after a few days the characteristic spectrum lines of helium appear. Thus a known element is produced during the transformation of radio-active matter. The alpha particles expelled from radio-active matter, after losing their positive charge, become atoms of helium. It has been conclusively shown that alpha particles from all types of radio-active matter are identical and consist of helium atoms carrying two positive charges, each equal to the charge on a negative electron. Every radio-active substance, which emits alpha particles during its transformation, gives rise to helium in proportion to its rate of emission of alpha particles. As an example of successive atomic transformation we have the established series, uranium, ionium, radium, helium.

The disintegration of uranium results in the expulsion of eight atoms of helium. The atomic weight of helium is very nearly four, and the eight atoms therefore weight thirty-two. Deducting the thirty-two from the atomic weight of uranium, 238.5, there is left 206.5. This is very nearly the atomic weight of lead, 207. Hence the suggestion that the end product of the disintegration of uranium is lead. The evidence derived from the study of uranium minerals makes it almost certain that lead is the final product of the disintegration of uranium. Much uncertainty remains relative to the end product of other radio-active substances. Atomic explosions result in a loss of alpha, beta and gamma particles, until the excess energy is exhausted and only the end product in each case remains.

The proof that negative electrons exist in all kinds of matter, has given a great impulse to the study of the constitution of the atom. The existence of atoms and molecules has been in no way changed by the discovery of electrons and their properties; but instead of pausing at the atom as the ultimate form of matter, the investigation is now carried further into the constitution of the atom itself.

One of the earliest hypothesis relative to the structure of the chemical elements was that they are built up of hydrogen. The atom has generally been supposed to consist of a number of positively and negatively charged particles held in equilibrium by electrical forces. These particles are no longer conceived to be hydrogen atoms, but the much smaller particles now known as electrons or aggregations of electrons. Thus the present prevailing view is that the atom consists of a sphere of positive electrification surrounded by a number of negative electrons moving around in minute orbits. Sir J. J. Thomson has investigated the several possible stable arrangements, and has found that different groupings differ widely in stability. Some may acquire an extra electron or two and yet remain stable. Others readily lose an electron without disturbance of their stability. The former would correspond to electronegative atoms; the latter to electropositive ones.

Atoms consisting of a number of revolving electrons may radiate energy very slowly, but the continuous drain of energy will finally result in a rearrangement of its constituent parts, or in the expulsion of electrons. This continuous loss of energy, which is known to take place in the case of radioactive bodies, may be the cause of their disintegration.

The great discovery of radiant matter by Crookes has been followed by the complete identification of cathode rays and beta particles from radium and other radio-active substances. They consist of electrons carrying or composed of the negative atom of electricity, and their mass is only 1/1800 that of the hydrogen atom. They are thus the lightest bodies known to science. They are given off by electric force, by light, by heat, and even spontaneously in radio-active bodies.

Further, since the alpha particles from whatever source consist of helium atoms, and helium is widely distributed in the earth, the sun, and in many stars, as shown by the spectroscope, it would appear that helium is one of the more elementary substances from which the heavier atoms are built. It is significant in this connection that the atomic weights of a number of elements differ nearly by four, the atomic weight of helium. The positively charged center of the atom consists in part at least of charged helium and hydrogen, though it is difficult to see how these parts are held together.

Nor is it at present conceivable in what manner the heavier atoms were originally built up from the lighter ones. The process of disintegration does not appear to be reversible. Enough mystery still remains in the constitution of matter to occupy the mind of man in its solution for generations to come. But it is the glory of this age that a great step in advance has been taken.

WASHINGTON ELECTRIC LIGHT AND POWER STATISTICS.

Preliminary figures of the forthcoming quinquennial report on the central electric light and power stations of the state of Washington have been given out by Director W. J. Harris of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of W. M. Steuart, chief statiscian for manufactures.

The statistics relate to the years ending December 31 for 1912 and 1907, and June 30 for 1902, and cover both commercial and municipal electric plants. They do not include electric plants operated by factories, hotels, etc., which consume the current generated, those operated by the Federal government and state institutions, or plants that were idle or in course of construction.

The decreases shown in 1912 as compared with 1907 are due to the fact that the report for electric railways in 1912 includes a number of the important companies that in 1907 were reported as central electric stations. By combining the totals for several of the items of physical equipment for the central electric stations and the electric railways, a more correct idea may be had of the electrical industry in the state, which increased since 1907 as follows: Primary power, from 109,661 horsepower in 1907 to 341,701 horsepower in 1912; the kilowatt capacity of the dynamos, from 94,987 in 1907 to 209,913 in 1912; and the output of stations, from 283,302,190 kw.-hr. in 1907 to 510,822,553 kw.-hr. in 1912.

The figures for central electric stations are given in detail in the accompanying table:

Washington.

	1912.	1907.	1902.	Per cent of increase: 1902-1912.
Number of establishments	70	71	40	75.0
Commercial	60	65	33	81.8
Municipal	10	6	7	42.9
Total income[1]	$3,087,721	$3,410,542	$783,651	294.0
Light, heat, and power	$2,976,297	$3,219,814	$739,743	302.3
All other sources	$111,424	$190,728	$43,908	153.8
Total expenses, including salaries and wages	$2,270,132	$2,388,628	$651,495	248.4
Total number of persons employed	1,078	885	274	293.4
Total horsepower	95,884	67,224	22,894	318.8
Steam and gas engines (including turbines):				
Number	58	54	38	52.6
Horsepower	18,293	10,764	5,553	229.4
Water wheels:				
Number	64	48	41	56.1
Horsepower	77,591	56,118	17,238	350.1
Auxiliary engines:				
Number	[2]	12	10	.....
Horsepower	[2]	342	103	.....
Kw. capacity of dynamos	57,283	66,308	13,679	318.8
Output of stations, kw.-hours	71,414,473	257,785,236	19,722,262	262.1
Estimated number of lamps wired for service:				
Arc	4,729	[3] 6,771	2,977	58.9
Stationary motors served:				
Number	2,279	1,933	295	672.5
H.P. capacity	28,148	29,686	2,780	912.5
All other varieties.	781,244	[3] 624,865	108,443	620.4

[1] Exclusive of $4,422,080 in 1912; $1,182,423 in 1907; and $641,800 in 1902, reported by street and electric railway companies as income from sale of electric current for light or power or from sale of current to other public service corporations.

[2] Not reported separately.

[3] Exclusive of 256 arc and 5677 lamps of other varieties reported by the electric companies as used to light their own properties. Lamps used for such service were included in the number reported for 1912.

IDAHO, NEVADA, UTAH, AND WYOMING ELECTRIC RAILWAY STATISTICS.

Preliminary figures for the forthcoming quinquennial report on the electric railways of the states of Idaho, Nevada, Utah, and Wyoming have been given out by Director W. J. Harris of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of W. M. Steuart, chief statistician for manufactures.

The statistics relate to the years ending December 31 for 1912 and 1907, and June 30 for 1902. The totals include electric light plants operated in connection with electric railways and not separable therefrom, but do not include reports of mixed steam and electric railroads nor railways under construction during the census year which had not begun operations.

The figures as presented for these states show substantial gains for the decade 1902-1912. The operating companies numbered 12 in 1912 as compared with four in 1902. There were 383 miles of track in 1912 as compared with 92 in 1902. The number of persons employed was 1448 in 1912, the figures for 1902 not being available. The revenue passengers carried in 1912 amounted to 46,770,646 as compared with 11,807,841 in 1902. The gross income for 1912 amounted to $3,894,371, the figures for 1902 not being available. The operating expenses in 1912 amounted to $2,097,899, the figures for 1912 also not being available. The horsepower of the power plants was 41,286 in 1912 as compared with 960 in 1902. The output of stations in 1912 amounted to 34,846,894 kw.-hr. as compared with 776,125 in 1902.

The figures are given in detail in the accompanying table:

Idaho, Nevada, Utah and Wyoming.

	1912.	1907.	1902.
Number of companies	13	7	4
Operating	12	6	4
Idaho	3	2	1
Nevada	2	1	.....
Utah	5	3	3
Wyoming	2	.....	.....
Lessor	1	1	.....
Miles of line	308.97	132.79	61.33
Miles of single track	383.29	173.93	92.54
Miles of single track in states [1]	423.49	202.78	92.54
Idaho	129.13	73.09	3.50
Nevada	11.27	7.15	.....
Utah	260.18	122.54	89.04
Wyoming	22.91	.....	.....
Cars, number	529	233	161
Passenger	327	179	152
All other	202	54	9
Electric locomotives	8	3	.....
Persons employed	1,448	918	(2)
Salaried employees	210	120	(2)
Wage earners (average number)	[3] 1,238	798	(2)
Power:			
Horsepower, total	41,286	12,150	960
Steam and gas engines (including turbines)			
Number	7	5	4
Horsepower	26,186	2,550	900
Water wheels:			
Number	11	10	1
Horsepower	15,100	9,600	60
Kw. capacity of dynamos	24,900	8,525	824
Output of stations, kw.-hr	34,846,894	22,204,231	776,125
Current purchased, kw.-hr	45,163,875	(2)	(2)
Passengers carried	54,646,899	28,599,353	14,114,159
Revenue	46,770,646	23,052,455	11,807,841
Transfer	7,108,268	5,243,733	2,306,318
Free	767,985	303,165	(2)
Car mileage (passenger, express, freight, etc.)	8,718,772	5,176,050	3,211,472
Condensed income account of operating companies:			
Gross income	$3,894,371	$2,087,888	(2)
Operating expenses	$2,097,899	$1,287,794	(2)
Gross income less operating expenses	$1,796,472	$800,094	(2)

[1] Including track in state owned by outside companies.

[2] Figures not available.

[3] Number employed Sept. 16, 1912.

PRESERVATION OF POLES AND PILES.

In replacing a burned railroad trestle on the north shore of Great Salt Lake, engineers found that the piles were still perfectly sound after 43 years of service. Looking for the cause, since these were only of local pine and fir, they found that the timbers were impregnated throughout with salt from the lake.

At another point on the lake, 18 in. piles, set 29 years ago, are similarly preserved with salt which has penetrated to their very center. Timbers in the Southern Pacific trestles across Salt Lake, placed in 1902, appear to be as good as on the day when the piles were driven. They have been preserved well above water line by the salt dashed onto them by the waves, a fact apparently anticipated by the engineers who built the trestles.

The first transcontinental telegraph line which was built before the railroad, extended west from Salt Lake City through the prosperous mining camps of Eureka, Austin, and Virginia City. When the railroad was built, the telegraph line was transferred to follow its right of way and the old poles sawed off at the ground. An engineer who recently examined the butts left in the ground in the salt desert near Fish Springs found that, although fifty years had passed since the poles were cut off, the old butts were perfectly sound.

Telephone and electric companies in the Salt Lake valley have used the local salt for preserving poles. When set up, about 75 lb. of salt is placed around the pole on the ground. This method cannot be used, however, when the pole is on or near a lawn, or in any place where vegetation is desired.

It is pointed out that the reason why the waters of Salt Lake act as a strong preservative, as distinguished from ocean waters, is because the lake water is so much saltier, being practically a saturated solution. Preservation with salt is of no use in ocean piling against the attack of teredos and other marine borers.

Experts in the forest service of the U. S. Department of Agriculture, who have been investigating the preservative treatment of timber, offer the suggestion that ties and poles which have been immersed for some time in the waters of the lake should be impervious to decay if the salt is not leached out by the action of the elements. It has been suggested that this can be guarded against, for example, by painting the butt of the pole with a coat of creosote which will keep out the moisture and keep in the salt.

Aluminum carbo-nitrate is an atmospheric nitrogen fixing compound which may be prepared by heating one part of alumina flour with two parts of ground carbon to a temperature of 1080 degrees C. in an atmosphere of nitrogen.

The total railroad mileage in Oregon is 3278 of which 426 is electric road mileage. The electric roads show well in revenues in proportion to their mileage, the 426 miles of electric line having yielded during 1913, $1,643,680.28 in net operating return, after deducting over half a million dollars in taxes, or about twice the return per mile, taken collectively, made by the steam lines.

CONDENSING EQUIPMENT.

BY FRANK R. WHEELER.

(This article discusses the various types of condensers and describes the limitations and advantages of each, the cycle of operation, the auxiliary apparatus required, and styles used.—The Editors.)

One pound of dry steam at 150 lb. pressure expanding adiabatically to one pound pressure will deliver approximately 132,000 ft. lb. of work. If the same quantity is then expanded to 28 in. vacuum it will deliver approximately 117,500 ft. lb. In the first stage it has increased in volume 7.166, and in the second 12.1 times or a total increase of 86 2/3 times its original volume. It is the ability of the steam turbine to handle the large volumes of the lower pressures efficiently, that is responsible for the decided progress that has been made in condenser practice within recent years.

In the days of Haswell's Handbook, a surface condenser problem was easily solved by providing one square foot of cooling surface for 10 lb. of steam to be condensed. As the result of extended experiments by Weighton, J. P. Joule, James Alexander Smith, G. A. Hagemann, Geo. A. Orrok, and several manufacturers specializing in this line, the solution of the problem is now possible on an engineering basis. Vacuum desired; temperature of cooling water; velocity of water through the tubes all affect the cooling surface required. Power requirements of auxiliaries must be capitalized and pumping head may justify a larger surface to reduce friction head and power requirements. Local conditions, quality and quantity of cooling water available determine which of three general types should be used. They are:

Low level jet condenser using short steam connections, in which the water removal pumps operate against the total head corresponding to the vacuum. In this type the steam and injection water are brought in actual contact.

Barometric, a jet condenser, in which the vacuum in the condenser is utilized for part of the pumping head.

Surface condenser in which steam and cooling water are separated by metal walls.

Certain characteristics of each type follow:

The low level jet, placed directly under a turbine is gaining ground on account of simplicity, small maintenance and first cost, and space requirements. In this type, the cooling or injection water is broken up into films or small bodies and the steam to be condensed brought into intimate contact with the water.

In a jet condenser designed on the "counter-current" principle, steam is introduced below the injection supply and the air suction is so arranged that the air must pass through the coldest water, thereby reducing its volume and necessary capacity of air pump.

The condensed steam and warmed injection water is removed from the condenser base, usually by centrifugal pumps which must be efficiently water sealed to prevent their becoming air bound. A centrifugal pump operating under this service (approximately 28 ft. suction head) must be designed to take its supply at velocities about one-half those used in ordinary service.

Where an abundant supply of fresh water suitable for boiler feed is available the jet type demands consideration but its advantages of lower first cost and space requirements must be balanced against greater power requirements, for the water removal pumps are working against a constant suction head corresponding to the vacuum maintained plus the discharge head, while with a surface condenser it is often possible to limit the total water pumping head to condenser and piping friction. The air pump too, requires about double the power of a surface condenser pump, for it must remove the air liberated from both the injection water and the condensed steam.

Due to "Handbook" formula and guarantees made for test conditions, it is often assumed that jet condensers use less cooling water than surface condensers. This could be true under uniform load, but under any other condition a surplus of water must be provided. To illustrate, assume just sufficient injection water provided to condense the steam passing to the condenser under which condition a temperature difference of 5 degrees F. could be maintained between outgoing injection water and temperature corresponding to the vacuum. Assume an increase of load without increase of injection water, then more heat will be, provided than can be absorbed, the water will boil and the vacuum break with all the unpleasantness incidental thereto. It is therefore customary, in practice to operate with 10 degrees temperature head, the same as a surface condenser, and use practically the same quantity of water. Two manufacturers now make the low level type of condensers with the water removal pumps submerged in the condenser base. These pumps with an air pump of the hydraulic entrainment type, are direct connected and driven by a small turbine. This makes an exceptionally compact and efficient rig. The barometric condenser for small units, low vacua and favorable water conditions, is deservedly popular, but the difficulty of keeping the necessary long exhaust lines tight and expense has caused this type to lose the prestige it enjoyed some years ago.

The surface condenser is, in its elementary form, a chamber containing a number of tubes carrying cooling water. Steam vapor carrying air, is admitted to the chamber, the steam condensers forming a partial vacuum which is maintained by the air pump. Each square foot of tube, or cooling surface has a maximum capacity to convey heat from the steam to water, which quality is effected by material; cleanliness of tube surface; temperature and velocity of cooling water and keeping the cooling surface free from envelopes of condensed steam and air. Weighton in his tests brought this latter into prominence providing drain plates to carry off the condensed steam, and it was quickly put into commercial use as a "Dry Tube" condenser, and, as is sometimes the case, its most prominent exponent adapted it on the "cure-all" principle, with results that tended to discredit the real merit of the design. Commercially it finds its use in condensers where the dimensions from top to bottom tube exceed 42 in. It is also necessary to free the tubes of air envelopes left when the steam is condensed. This is done by arranging a decreasing cross-sectional area and maintaining a constant velocity through the condenser. One manufacturer provides a spiral guide, an idea first used by Capt. Wadogaki of the Japanese navy, and another a heart-shaped shell. What seems the best method, however, is to provide differential spacing of the tubes. For ex-

ample, in a three pass condenser having one inch tubes, the upper bank would be spaced 1⅝ in. centers; the middle bank 1½ in. centers; and the lower bank, the standard, or 1⅜ in. centers. This arrangement combined with drain plates is probably the most efficient design obtainable in the American market.

An important detail often overlooked by the buyer and specification writer, is to call for the tubes to be held into tube plates at both ends by screwed ferrules; the ferrules to have liberally proportioned shoulders for the entire circumference of the tube. Tubes will split and corrode and the commercial factor has compelled the setting of the tubes on such close centers that expaned ends necessitate a new tube plate if more than two tubes are lost at the same point. The advantage of a full shoulder is obvious. The shape of the condenser shell varies, but if the steam passages are properly designed, there can be no themodynamic gain in any particular form. A circle encloses the greatest area for its circumference and the cylindrical form is therefore the most used and has the additional advantage of being stronger for a given weight.

Referring particularly to surface condensers, the presence of air has two very objectionable features; first, raising of the total pressure in the condenser; second, insulating the tubes and decreasing their capacity as a heat conductor. Raw, or fresh boiler feed water, that has not been re-evaporated and condensed through the system contains more than four times the entrained air than water in the system; therefore, when a turbine is started, or a fresh boiler cut in on account of peak or overload, we are imposing on the air pump a maximum or overload at just the time when it is most needed, for the resultant drop in vacuum is cumulative and would soon stall a plant not provided with a liberally proportioned air pump. This point is made to impress on engineers the fallacy of buying condensing equipment, where the air pump is undersized, because it is "guaranteed." The guarantee usually reads for a stated capacity per hour, overloads usually come in minutes, and "Guarantees" never condensed a pound of steam. The additional cost of the next stock size pump is money well spent, for given the same temperature and piping, no one maker can make a square foot of cooling surface radiate more heat units than another, notwithstanding some enthusiastic salesmen. The air pump is the heart of the system and deserves consideration as such.

Steam brought in contact with a cooling medium gives up its latent and sensible heat and condenses to water at a temperature corresponding to the vapor pressure in which it is contained. Assume a definite weight of steam condensed in a closed vessel, then the space formally occupied by the steam will be absolutely empty except for the water of condensation, and at zero pressure if it were not for the pressure of the water vapor corresponding to the water temperature, and the pressure of the air admitted with the steam. Since all water contains air, all steam generated from water contains air. This constant accumulation of air in a condenser, if not removed, would soon affect the condenser pressure materially, for by Dalton's Law, the total pressure in the condenser chamber would be the sum of the pressure exerted by the water vapor and air.

It is the function of the air pump to remove the air carried over with the steam and admitted through leaks in the systems. Remembering that a unit weight of air increased in volume approximately 16.2 times when the pressure is reduced from atmosphere to 28½ in. vacuum and that to remove this air it must be compressed back to atmospheric pressure, it is readily appreciated that to do this in one cylinder and maintain tightness involves some care in design. There are three general types of air pump on the market:

Wet vacuum pumps, in which both the condensate and air are removed in one cylinder. The Rotrex, Edwards and Mullan are the best known examples, and for units up to 2000 kw. they make very attractive installations on account of their simplicity and reducing to a minimum the number of auxiliaries on which continuity of operation depends. They have the additional advantage that a split condenser tube or sudden overload carrying considerable quantity of water would have no ill effect on the system. The above types are made suction valveless and with clearances between moving parts sealed by the water of condensation. and they will produce a vacuum under dead end within 0.2 to 0.5 in. of the barometer, the operating limit being usually dependent upon the temperature of the circulating water.

Dry vacuum pumps are made with a minimum of clearance and handle air only, the condensate being removed by an independent pump, usually a centrifugal, motor or steam turbine driven. Dry pumps should always be made with their discharge valves under the cylinder to provide drainage for any entrained moisture, and with flashparts which momentarily connect the two ends of the cylinder at the end of the stroke. This evacuates the clearance space and increases volumetric efficiency. On account of the necessary small clearance the admission of water in any quantity would ruin the pump as has often been demonstrated. This and the excessive size to accommodate the large volumes is responsible for the trend toward the use of the centrifugal or hydraulic entrainment type.

This was developed in Europe and has been quite generally adopted by this country, with the Le Blanc, Thyssen, A. E. G., Kinetic, Ress and Josse as the best known examples. In principle they all depend on ejection action using water as a medium to evacuate the air from condenser chamber. The most efficient type employs a well designed centrifugal impeller to discharge a thin film of water at high velocity. Air is brought into contact with this film and forced through the entrainment rings by the velocity of the water. This type is not dependent upon the vacuum in the condensing chamber for its water supply, as is the case with some of the earlier designs. While the entrainment type of pump uses more power than the positive displacement type, the advantage of great simplicity, space requirements and ability to combine it with circulating or hot well pumps using a single turbine or motor to drive have made it deservably popular, particularly for low level jet condensers. Without doubt, it is the design that will be most generally used in the future, though not because it produces a better vacuum, as some manufacturers would have us believe.

LIGHTING METHODS

BANK LIGHTING INSTALLATION.

The First National Bank, Los Angeles, Cal., is located in the I. N. Van Nuys Building. The building, designed by Messrs. Morgan, Walls & Morgan, is a class "A" structure of the most modern type and of the highest standard. The first three stories are executed in granite and the superstructure in white terra cotta. The site occupied has a frontage on Seventh street of 155 ft. and on Spring of 170 ft.

The bank occupies the entire ground floor, a space, 100 by 170 ft., a large mezzanine floor in the rear, and the entire basement.

ing is the reflecting surface which diffuses the light throughout the interior, the intensity of illumination produced in a room, using a given amount of wattage, depends upon how much light really reaches and is reflected from the ceiling. The way to direct the maximum amount of light to the ceiling is to use the most powerful type of reflector obtainable, and in this instance mirror reflectors have been used exclusively.

A certain fixed intensity of light is necessary for agreeable and efficient illumination, and the problem lies in producing that intensity which will distribute the light on a horizontal plane about 36 in. from the floor.

Night View of Bank Interior Taken Without the Aid of Flashlight.

The interior design is original and has a distinctive character typical of the work of Messrs. Weary & Alford, of Los Angeles, who designed and furnished the entire decorations and equipment. The lighting system is particularly pleasing and is also unique.

From the inception of indirect systems, especially as applied to bank lighting, these decorators have paid especial attention to the scientific principles involved, which gives this article compiled from data supplied by them, an added value.

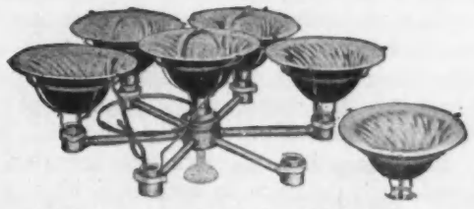
The success or failure of any installation of an indirect system of illumination depends principally upon the reflector and also upon the general color scheme of the room to be illuminated. As a light colored ceil-

In this particular installation there were a great many different rooms and spaces to be illuminated and the intensities had to be adjusted to suit the requirements of the occupants of the rooms. The illustration shown is a photograph taken in the bank with a 45 minute exposure without the aid of flashlights of any character, and illustrates especially the even distribution of light which has been obtained. Particular attention is called to the clearness in which the tessarae in the mosaic floor have been brought out, as well as certain discolorations in the marble.

The following is a description of the lighting equipment used in this main concourse:

There are twelve outlets in the center bays of the

room and fourteen in the bays at the windows. In each case an intensity of 4.0 ft. candles was figured upon, the room being 128x92 ft. in size, and 22 ft. from floor to ceiling. In the twelve larger fixtures six 100 watt lamps with the E-100 type reflector were used, and in the 14 other outlets five 100 watt lamps with the same type of reflector, in both instances the top edge of the reflector bowl being placed six feet from the ceiling. These values of foot candles are based upon the 1913 rating of clear bulb Mazda lamps, 25 per cent being allowed for depreciation for dust on lamps and reflectors and the blackening of lamp bulbs due to age.



Constructional Details of Fixtures.

The small illustration shows the type of equipment furnished in any shell which may be designed and great flexibility may be obtained by the use of standard receptacles, holders, bodies, nipples, etc., and by the use of the various types of reflectors obtainable from the manufacturers.

General engineering data for the entire equipment of the first and mezzanine floors will indicate how the type and size of reflector is arrived at after the intensity in foot candles is determined upon, and will prove valuable for reference:

Engineering Data First National Bank, Los Angeles.

Room.	Height of Ceiling. Ft.	Size. Ft.	Foot Candles. Area. Sq. Ft.	Est.	Outlets.	Mazda Lamps per fixture.	Reflector.	To Ceiling. In.
First Floor	12							
Auditor		17x19	323	4.	1	5-100	E-100	30
Stenographer		10x12	120	5.	1	4-60	E-60	36
Cashier		8x11	88	4.5	1	3-60	E-60	36
Women's retiring		11x9	99	2.5	1	2-60	E-60	36
Women's toilet		17x10	170	1.5	1	2-60	E-60	36
Filing		16x18	288	3.5	1	4-100	E-100	30
Directors'		28x17	476	3.5	2	3-100	E-100	30
Director's toilet		11x11	121	2.0	1	1-100	E-100	30
Clearing house		26x18	468	4.5	2	4-100	E-100	30
Court—								
1 bay		16x19	304	3.5	1	4-100	E-100	30
2 bays		28x19	532	3.5	2	4-100	E-100	30
1 bay		19x19	361	3.5	1	4-100	E-100	30
Foot of stairs		17x8	136	2.0	1	2-60	E-60	36
Main Floor—								
Court	22	128x92	11778	4.0	12	6-100	E-100	72
Ceiling				11.	14	5-100	E-100	72
7th St. entrance.		7x14	98	2.0	1	1-100	E-100	36
Mezzanine	9							
Statements		24x12	288	4.0	2	4-60	E-60	24
		19x12	228	4.0	2	3-60	E-60	24
Stationery		17x11	187	2.3	1	3-60	E-60	24
Women's retiring		17x18	305	2.0	1	4-60	E-60	24
S. W. corner		36x18	648	4.0	3	5-60	E-60	24
S. E. corner		48x16	768	4.0	3	6-60	E-60	24
Center		47x22	1034	4.5	6	5-60	E-60	24
Telephone		8x8	64	2.5	1	2-40	E-60	24

ANSWERS TO QUESTIONS.

(These answers submitted by a reader are in reply to the questions submitted in a recent issue. Readers are invited to use this department of Journal service as a forum for the discussion of their lighting problems.—The Editors.)

Mr. F. Laurent Godinez is a well-known Eastern decorator and illuminating engineer and his recommendations made in "The Lighting Book," can undoubtedly be accepted without reservation. It is possible that particular statements may not be fully understood by the layman reader.

I. It is understood that in this case it is desired to place a lattice work over the entire ceiling of the living room, a total ceiling area of approximately 600 sq. ft.

It would not be practicable under any circumstances to illuminate so large an area to a comparatively uniform intensity with two light sources. If subdued by the use of the colored gelatine film, the intensity would be lower and the effect not so spotty to the eye, but would still be impracticable.

On page 108 of The Lighting Book a suggestion is given for the proper lighting treatment of a narrow hall. A diagram is given which is self explanatory and with a low intensity of illumination from below thrown onto the lattice in order to relieve any great contrast betwen it and the light coming from behind, such an arrangement should prove eminently satisfactory to anyone desiring this moonlight effect.

In the problem referred to there is the suggestion that this lighting is to illuminate the room, but blue light is certainly impracticable in a living room and any extreme of any color not to be desired.

I can see no advantage whatever from such a system which with the use of the reading lamps suggested, none of which would throw much light on objects other than those immediately beneath them, would create a gloomy, depressing and undesirable effect.

2. Godinez recommends that in various places throughout the home, Mazda lamps should be reduced in brilliancy by placing gelatine film such as that used in theatres for stage effects, around them.

If required for any particular or special purpose this film can be secured from theatrical supply houses, but unless some such scheme has been laid out as that suggested for an artistic lighting effect in the hall, or for subdued lighting from urns and so forth, there can be no excuse for its use.

3. There are a number of architectural sculptors and modelers in San Francisco who make plaster urns such as that proposed by Godinez, but would suggest that plans for this urn be first prepared by a qualified engineer or fixture manufacturer as it is important that the electrical equipment and construction be given proper consideration. Composition lamp pedestals and lighting fixture bracket arms should be made by a fixture manufacturer. They are never as inexpenvive in the West as is stated by Godinez.

It should be considered that plaster is not exceptionally durable for this purpose Any artistic urn of pottery or even cement, could be properly equipped with a lamp and reflector and would prove more lasting.

The lighting of flowers and foliage in a low urn from below does not appear to be natural or correct. The practicableness of most things is proved by their present popularity and innovations must conform to natural requirements if they are to be permanent and a success.

Regarding the price to be paid for illuminating glassware. It is unfortunate that a book published in the East, should be accepted as verifying Western prices. In addition to freight on Eastern products such as lighting glassware, there is the greater cost of doing business in the West to be added to the price of all things. Any legitimate fixture dealer would secure special types of glassware but it would neither be fair nor reasonable for any person outside that dealer to say at what price the article shall be sold. The desire—the necessity—for business, where competition is as keen as it is in the fixture dealers' business, compel, as a matter of self-preservation or survival, the lowest price consistent with fair profit.

On the whole I would recommend that this home lighting problem be placed in the hands of a duly qualified illuminating engineer or fixture manufacturer with instructions to work in co-operation with the decorator—to the end of securing an effective modern and stay-satisfactory lighting installation.

J. A. S.

WATER POWER LEGISLATION

NEW AND PROPOSED REGULATIONS AFFECTING WATER POWER DEVELOPMENT.

BY L. F. HARZA.

(The author reviews present water power laws and the reasons for their existence in the present form. Touches upon new regulations as evidenced in the latest Forestry manual and the basis of those proposed based upon the report of the last National Conservation Congress. Mr. Harza presented this paper before the Portland, Oregon, Section of the A. I. E. E., February 3rd, 1914.—The Editors.)

It must be evident to all that we are passing through a period of revolutionary changes in laws relating to the use of our natural resources.

Not the least important, by any means, of our natural resources now receiving the attention of political reformers is the undeveloped water power of our rivers and streams. The business of utilizing this resource falls under the head of a public utility enterprise. For this reason water powers are subject not only to a regulation of the terms under which they may be developed, but also to a regulation of the selling price of the output, thus eliminating the law of supply and demand to a degree depending upon the extent to which the doctrine of rate regulation has been applied in the state in question.

Originally it was held by the Federal courts that where property was effected by a public use, the regulation of rates was a matter solely of legislative discretion, not to be interfered with by the courts. (Munn v. Illinois, 94 U. S. 113; Granger Cases, 94 U. S. 155, 164, 179, 180, 181.) Now we see these matters taken entirely out of the legislative branch and entrusted to administrative bodies with subordinate judicial powers.

It has required some time for these regulatory bodies to thoroughly organize and for the establishment of sound precedent relating to disputed points by court reviews of their decisions. I believe I am correct in stating, however, that the gradual evolution of the principles governing physical valuations have tended toward an increasing breadth of view favorable to the operating companies. Certain elements of "present value" under dispute at first are now recognized by the most important decisions as legitimate. Among these may be mentioned: (1) going value, (2) promotion expenses, such as commercial, engineering and financial reports on the proposed undertaking (3) organization expenses, such as expenses of incorporation, legal expenses of passing on titles to real estate, preparing form of bond and other necessary instruments, such as franchises, licenses, etc., (4) promotion profits, (5) engineering, (6) interest, taxes, and legal expenses during construction, (7) brokerage and discount on bonds, and (8) working capital.

It was my intention, however, to merely mention the matter of rate control and to speak especially of new and proposed measures effecting the development of hydroelectric power, upon the assumption that there are at least some present who have been too busily absorbed in their respective duties to follow recent activities in that line. It is not proposed that this paper will contain much, if any, originality, but merely a resume of the present situation.

The question of acquiring title to water rights for power development must be considered under four heads: (a) Intrastate non-navigable streams, on patented or state lands, (b) interstate non-navigable streams, (c) navigable streams, (d) non-navigable streams where the project is in some manner dependent upon lands still in the public domain.

(a) In the case of intrastate non-navigable streams on private or state lands, the jurisdiction of the individual states has not been questioned.

In the humid states of the Mississippi River Valley and eastward the common law doctrine of riparian rights has been almost universally applied. In some states it has always been necessary to secure a special grant from the legislature in each individual case for the construction of a dam for any purpose. This grant usually conveyed explicitly the right of eminent domain for the purchase of overflowed lands, although in some instances, notably in Michigan and New York, this right has seldom been granted.

The doctrine of "Riparian Rights," with which you are doubtless all familiar, is that every proprietor of land on the bank of a river has an equal right to the use of the water which flows in the stream adjacent to his lands, as it was wont to flow, without diminution, pollution or alteration, unless his right has been limited by grant, license or prescription. These rights are considered as inseparably annexed to the soil, and to pass with it, not as an easement or appurtenance, but as a part and parcel of the land, not depending upon appropriation and not suspended or lost by non-use.

The early settlers and miners in the West knew no rules of law. They diverted water from the streams to suit their purposes, and not until the streams were depleted did questions of title to water arise. When called upon to settle disputes some courts were broadminded enough to recognize the doctrine of riparian rights to be utterly unfitted for an irrigation region and to apply the new rule of "first in time, first in right," or the doctrine of appropriation and beneficial use. Other courts tried to adhere to the common law doctrine of riparian rights and to adjust it to meet the new conditions. Conflicting decisions and almost endless litigation has resulted, with the consequence that the ablest lawyers in some Western States admit that they do not know what the law is, and that the only good water title is one gained by prescription or adverse use.

In some cases the cost of litigation has been known to double the cost of development work, and often adds a large percentage. This condition of affairs has placed a great load upon all hydraulic developments in defending themselves against others claiming as both prior appropriators and as riparian owners on the same stream. Under these conditions development can be carried out only in instances where anticipated profits justify the legal hazard involved, or by a large corporation with other and perhaps diversified assets securing the development bonds.

Some Western States, notably Wyoming and Oregon, have set the precedent by instituting a revised water code; eliminating the doctrine of riparian rights and substituting that of priority of appropriation and beneficial use; creating a state board, with subordinate judicial powers, for administering this code, including the investigation, filing and recording of water right applications; the issuance of water right certificates, comparable to a deed of land, upon final proof by the applicant that the water has actually been put to beneficial use; the adjudication of old water rights; and the actual supervision of the distribution of the water according to titles thus granted or adjudicated. The Washington legislature failed to pass a similar code at the last session, but eventually it is to be expected that they, as well as other states, will follow the lead of Wyoming and Oregon in modernizing their water laws.

(b) In the case of interstate streams the uncertainty of water titles is even far greater. This arises from the fact that each state claims jurisdiction over all non-navigable water within its borders. It resulted in the continued appropriation of water from the Arkansas River in Colorado until prior irrigators in the lower State of Kansas, as riparian proprietors, were deprived of their former water supply. The United States Supreme Court refused relief, after protracted litigation, costing the State of Kansas about $200,000, on the grounds that the yet lower State of Oklahoma would then have equal cause for action against both Kansas and Colorado, with evident ruinous effect on all irrigation developments in these states, although implying that when a more substantial injury could be shown Kansas might be entitled to recover. (See Kansas v. Colorado, 206 U. S. 46.)

This case brought out three points: (1) The incompatibility of the doctrine of riparian rights with the necessities of an irrigation region; (2) the injustice of government by injunction, presupposing as it does the existence of the damage, as compared with a system of determining water titles before development and recording them in much the same way as land titles: (3) the need of an interstate or Federal law determining the relative standing of the rights of irrigators in the two or more states of an interstate stream.

Several other cases of this sort have arisen, and yet investors are still at sea as to what rights they can safely defend upon interstate streams. If a state is sole proprietor of its non-navigable waters, then Wyoming, Colorado and other states on the continental divide may divert or store all the water of their streams without reference to prior appropriators in the lower states; and if not, then it is maintained by Mr. John H. Lewis, State Engineer of Oregon, that there should be a national water code applying to interstate streams and administered by a national commission similar to the Oregon State Water Board.

This is not only necessary for irrigation and power development in the Western States, but applies also to the Eastern and Mississippi River Valley States, where extensive storage and other river improvements will undoubtedly be undertaken before many years to relieve the flood menace in that region. The benefit of these improvements will accrue to all of the lower states, to power interests, cities and drainage districts and benefits must be assessed by some form of an interstate administrative commission.

(c) Navigable streams: The jurisdiction of the Federal Government over all improvements on navigable streams to the extent of maintaining their navigability is generally recognized. The ultimate necessity of extending this jurisdiction to include their non-navigable tributaries is only beginning to be recognized. This necessity, to be sure, will be the most felt in irrigation regions where extensive diversions may ultimately complicate the navigation problem.

Two noteworthy papers dealing with the foregoing subject of better water laws have recently been presented before the American Society of Civil Engineers by Mr. H. T. Cory and Mr. John H. Lewis, and have been very widely discussed by the leading hydraulicians. Most of the ideas above stated were gathered from the latter's paper. A reading of these papers cannot but impress one with the urgent demand for water law reform along with that of tariff, currency, trusts, etc.

In conjunction with the presentation of this paper Mr. Lewis submitted a motion to the Society providing for the appointment of a committee to prepare a preliminary draft of a national water law to be applicable to all navigable, interstate and other waters within the jurisdiction of the United States. This committee has been appointed and its personnel insures a very efficient handling of the problem. Their report will be watched with great interest by all.

(d) In the case of developments on non-navigable streams and dependent upon government land two cases must be considered, depending upon whether the required land is in the forest reserves or in the remainder of the public domain.

[To be continued.

LETTERS TO THE EDITOR.

An Author's Correction.

Stanford University, Cal., March 16, 1914.

Referring to my contribution to the discussion of the Taylor paper on "The Electrical Precipitation of Cement Dust," as reported in the March 14, 1914, issue of the Journal: Circumstances required me to send in my remarks by autographic letter. The result is that my writing was misunderstood in one word of importance, start in lieu of "short" as it appears in your printed copy of my letter. This word is used twice in the letter. The corresponding phrases should read "required to start conduction" and "start-of-conduction" in lieu correspondingly of "required to short conduction" and "short-of-conduction."

If entirely convenient and agreeable to you to do so I should be glad to have you call attention to this mis-print in your next issue.

Cordially yours,

(Signed) HARRIS J. RYAN.

Non-corrodable anodes and all metals which do not form insoluble end products of corrosion never cause cracking of concrete as a result of the passage of an electric current.

The fuel consumption of a Diesel engine per brake horsepower hours varies in inverse proportion to the heating value per pound of fuel used, for any given engine and load condition. A fair average is 0.45 lb. with an 18,500 B.t.u. oil, averaging 7.5 lb. per gallon.

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advanace of date of issue.

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George Westinghouse

On the twelfth day of March, nineteen-fourteen, George Westinghouse, engineer, inventor and manufacturer, passed out at the age of sixty-eight years, honored, alert and active to the end. Nearly fifty years ago he commenced to live the safety-first idea, which developing with the lapse of time has just found expression in the minds of all.

In a description of the use of three thousand feet of pipe for conveying compressed air to the Mount Cenis tunnel boring machinery, he saw the principle of his air-brake, which was later to be universally adopted, though at first ridiculed, and destined to save lives innumerable and to make rapid travel feasible.

Westinghouse desired to avert railway accidents, the disastrous effects of which had appalled him. He saw according to his dominant thought and had the courage and other requisites to a successful issue. He was then not twenty-two.

The development of alternating current machinery was also one of his great achievements; the collosal industries which bear his name are known throughout the world.

Labor can pay its respects to Westinghouse as being responsible for the introduction of the Saturday half-holiday into the United States; an institution which makes for liberty in labor and greater contentment. It is small wonder that he inspired the loyalty of all, and that throughout his long and eventful business career, labor disputes with him were not known.

This brief editorial does not attempt to catalogue all his virtues or achievements. It is a passing tribute to one who, as a product of the great age of industrial achievement, so served mankind that he will live always—in the betterment of things and conditions made possible by the trinity of labor, the work of his head, heart and hands.

The Municipal Lighting Plant

Contrary to the general belief, the growth of municipal lighting plants is not so great as to furnish fear to the advocates of private ownership or to produce pleasure to those who think public ownership preferable. Considering the tremendous growth of the industry, the statistics just published by the Bureau of the Census show that relatively little progress has been made.

But public ownership of the city lighting plant still furnishes the organ upon which the politician strikes a chord of profits to accrue, attuned for ready response in the mind of publics not yet educated to the contrary viewpoint—the greater profits which may result when private corporations instead, are allowed to serve their needs.

Sporadic municipal ownership causing a temporary disruption of the present order is inevitable.

A further cause is that the rate of expansion, due to the inventive spirit fostered by private ownership has been so rapid, that these corporations have, in general, failed to keep the public fully informed as to the remarkable merit of the service rendered, the

reasons for its excellence, the tremendous cost of its perfecting, and the advantage of its continuance.

And because they have not been properly informed, these publics, swayed momentarily by the opposite idea, assume that they can command the earth to stand still that the sun's rays will ever shine beneficently on them.

But to stand still, is to retrograde.

With the removal of private ownership, the main incentive for invention, improvement and progress, it becomes but a question of time before its advantages again become apparent. Municipalities then discontinue their experiment of public ownership.

It is interesting here to note that during the years 1902 to 1907 the number of new municipal plants aggregated four hundred thirty-seven, while from 1907 to 1912 the net increase was only three hundred ten. During this last mentioned period the total capacity of the generating equipment of both municipal and private plants was practically doubled.

Eighty municipal plants were changed from municipal to private operation during that period and seventeen were discontinued, these figures being obtained from the U. S. Census reports.

There has apparently still to be reckoned the hazard of municipal ownership.

In making comparisons between public and privately operated plants it is usual to show the results only in dollars and cents, but of even greater importance, if the public would but appreciate the fact, would be a comparison showing the service secured for each dollar of expenditure.

The privately owned utility sells service, and is always alert for new uses for its product that increased profits may accrue.

It is believed by many that commission control has temporarily altered this condition by making the earnings of utility corporations consequent only upon investment.

In this way the commission has, perhaps unwittingly, pursued obstructionist tactics opposed to the best interests of the public.

It would appear that these commissions must, in self-preservation alone, again permit private corporations to measure their profit by the service rendered.

The incentive to improvement is what constitutes the real difference between public and privately owned utilities. It is not so much the lower rates but the better service rendered which measures the relative value of each.

If all available data were taken into consideration municipalities would almost invariably find, if they wish to try the experiment of public ownership, that it will be to their advantage to first own only their own distribution systems, purchasing the current in bulk from a privately owned corporation.

Should the passing of a reasonable period prove the experience profitable, there will then be ample time to make arrangements, if found desirable, for a complete plant.

It is reasonable though to anticipate a sale of the distribution system to the private corporation. Cities and towns cannot afford to indulge the apathy consequent, for example, upon inefficient lighting. Light is the life of a community and a city is often judged by its brightness.

It needs the enterprise and aggressiveness of private operation, assured a "reasonable" rate of return in order to keep a city abreast the lighting progress made.

Does the saving to each citizen of a few cents on his monthly lighting bill justify the sacrifice of this community good?

Regulation by Competitors

Regulation by the people combined with competition from the same source comes perilously close to making it impossible for other than the people to engage in whatever is profitable business. The risk is too great and capital may be forced either to find other fields or to hide in the long stocking. Such is the effect of too much regulation.

Because of competition from the government parcels post system combined with enforced reductions in rates by the Interstate Commerce Commission, notwithstanding a steady decline in its earnings, the directors of the U. S. Express Company are reported to have voted unanimously to liquidate its affairs and to dissolve in the shortest possible time.

It looks as though the rates forced upon this company must have been based upon assumptions instead of actualities, which has compelled a repudiation of this practice by the business interests at stake.

The paths of public and private ownership have met at the vanishing, or rather, vanquishing point, at which the very basis of business is threatened. Is the reward of success now to result in confiscation or annihilation?

The effect of this action on employes must also be noted. Statistics show continually the remarkable salary increases both as regards the total and the per capita earned, due largely to the past stupendous industrious development and era of business freedom.

As a result of the action forced upon this express company sixteen thousand employes will be temporarily out of employment with the consequent, to them, tremendous loss. The annual payroll of this comparatively small company was over six million dollars.

The conditions necessitating the action taken by the company exist in degree on the Pacific Coast where in several cities, the power which controls or regulates the rates of public utilities is or may be in direct competition, in the form of municipal ownership, with these same public utility corporations.

This is wrong in principle and apparently disastrous in practice. It should be changed.

Let us have either fair and open competition or regulated monopoly, for with even a measure of success or justice, competition regulated by one of the competitors, seems impossible.

One, perhaps satisfactory solution of this problem, would be to have all public utilities including those municipally owned and those private corporations within cities all controlled by the state public service commissions, though these are first cousins german to the public.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

F. B. McAvoy of the Reno Electric Works, Reno, Nevada, is at San Francisco on Business.

W. R. Lyall of the D. & W. Fuse Company, is at Portland, Oregon, and will visit in that city for several days.

Elmer Dover of the H. M. Byllesby Company, has returned to Tacoma, Wash., from his California visit.

Earl G. Wilson, one of the leading electrical contractors of Napa, Cal., was a recent visitor at San Francisco.

J. I. Colwell, local manager of the Western Electric Company, has returned to Seattle from San Francisco.

M. E. Fibush has accepted a position as city salesman with the Brooks Follis Electrical Corporation, San Francisco.

Leroy Nash, salesman for the Pacific States Electric Company, has been transferred to the Oakland house of that company.

C. V. Schneider and **A. E. Peck** of the Electric Supply Company, Sacramento, Cal., were among the San Francisco visitors this week.

C. E. Wiggin, sales manager electrical department Dunham, Carrigan & Hayden, San Francisco, was at Sacramento during the past week.

E. H. Taylor, of the firm of Pease, Bundy, Taylor Company, electrical engineers and contractors, is at San Francisco from Porterville, Cal.

H. T. Hayes, assistant general manager, Mt. Whitney Power & Electric Company, Visalia, Cal., paid a visit to San Francisco during the past week.

E. E. Gray, representative of the Hotpoint Electric Heating Company, Ontario, California, is in Salt Lake City this week on his regular spring trip.

H. C. Hoover, secretary of the trustees of the Schloss Securities, is at present in England in connection, it is stated, with the refinancing or re-organization of Natomas Consolidated.

B. M. Smarr, until recently, lighting expert in the San Francisco office of the General Electric Company, is now sales manager for the Mohlite Company, with offices at San Francisco.

R. E. Smith, California representative of the National X-Ray Reflector Company, has just returned to San Francisco, having made an extended business trip throughout the state.

John F. Greenwald, of the Mountain States Telephone & Telegraph Company, has been transferred from the public relations department of the company at Helena, Montana, to Salt Lake City.

A. L. Valentine, superintendent of public utilities, Seattle, Wash., will have supervision of the municipal car line to be put into operation either the latter part of March or early in April.

W. S. Cozad, general traffic superintendent of the Mountain States Telephone & Telegraph Company, with headquarters at Denver, is in Salt Lake City going over the company's traffic conditions here in Utah.

J. H. Moseley, formerly with the advertising department of this journal and now with the commercial department of the Pacific Gas & Electric Company, has been hurriedly called East on account of the serious illness of his mother.

Ross Perry has entered the employ of the Capital Electric Company of Salt Lake City as an electric sign specialist, and will devote his entire attention to the enlargement of the sign business of this rapidly expanding concern.

Arthur Walser, district manager of the small motor department of the General Electric Company, has transferred his headquarters from Denver to Salt Lake City on account of the activity in the motor line in the territory served by the Salt Lake City office.

F. J. Mills, business manager, California-Oregon Power Magazine, Yreka, Cal., is spending a few weeks at San Francisco, combining business and pleasure.

C. Masson, illuminating engineer, Southern California Edison Company, Los Angeles, Cal., has been elected a member of the Illuminating Engineering Society.

W. D'A. Ryan, of the General Electric Company, returned to San Francisco during the past week after having made a business trip East on company business and on matters of importance in connection with the lighting of the P.P.I.E.

A. B. Richmond, secretary of the Olston Electric Stove Company of Los Angeles, stopped over in Salt Lake City on his way to Boise, where he has been called on business connected with the opening up of a market for their product in that territory.

C. R. Seigel, division traffic superintendent of the Mountain States Telephone & Telegraph Company, with headquarters at Salt Lake City, has resigned his position and has gone to San Francisco in an effort to improve his health, which has been failing him for the past several months.

Thomas Mirk, of Hunt, Mirk & Co., engineers and contractors, San Francisco, Cal., has returned from a successful business trip to San Diego, made in connection with the new equipment for the San Diego Electric Railroad Company, which company is arranging to build extensions to its system.

Joseph S. Wells, general manager of the Utah Light & Railway Company, accompanied by **L. L. Dagron** and **O. A. Honnold,** engineers of the company, made a trip of inspection last week to Ogden to inspect the company's power dam and pipe line in Ogden Canyon, which has recently been raised, enlarged and repaired.

W. E. Herring, industrial agent, Puget Sound Traction, Light & Power Company, will shortly leave Seattle for the East in order to close negotiations for the location in and about Seattle of a number of new factories. Mr. Herring feels confident that he will return to Seattle with assurances from the factories to this end.

W. L. Huber, consulting engineer, San Francisco, has been retained by the Cuyumaca Water Company of San Diego in connection with the utilization of the waters of Boulder Creek for the generation of electric power. The proposed power plant will be located a short distance below the company's Cuyumaca Reservoir. **W. S. Post** of San Diego is chief engineer.

Charles M. Schwab, president, Bethlehem Steel Corporation and now at San Francisco, expressed his belief in the future of the Union Iron Works, not only as a repair station on the great maritime highway that will be created with the opening of the Panama Canal, but also on account of the increased amount of shipbuilding that will take place at San Francisco.

George A. Damon, dean of engineering of Throop College of Technology of Pasadena, was the chief speaker at a meeting of the South Pasadena Chamber of Commerce at which he outlined a proposal of combining the Santa Fe, the Salt Lake & the Pacific Electric Railroads from Los Angeles to South Pasadena. It was stated that the plan was indorsed by the roads concerned.

Robert Sibley, professor of mechanical engineering at the University of California and special contributor to this journal, is at the present time recovering from a recent indisposition which although not serious has been sufficient to prevent editing instalments of his series of articles on "Elements of Fuel Oil Practice and Boiler Testing," which accounts for their non-appearance in this issue.

John C. Jones, Statesman for Utah of the Jovian Order, called a meeting on the 11th inst. to arrange the details for a rejuvenation to be held on April 21st concurrently with a general meeting of local representatives of the Utah Power & Light Company which is to be held in Salt Lake City on that date. Statesman Jones has designated a permanent team who are already at work preparing for this event.

OBITUARY.

George Westinghouse, the famous inventor and engineer, died at his New York City residence on Thursday, March 12.

His health had been failing for some time and consequently his death, though a great shock to his thousands of friends and acquaintances all over the country, was nevertheless in a measure anticipated.

The mental alertness and wonderful vitality that had so characterized his brilliant career remained with him to the end.

Although actively associated with a large number of industries, he had during the last few years begun to transfer his responsibilities to the shoulders of his trusted lieutenants, the fortunate selection of which has always been one of the leading characteristics of his varied career.

His demise therefore will not cause any material change in the policy of operation of the companies so indelibly linked with the name Westinghouse.

George Westinghouse was born at Central Bridge, Scholarie County, New York, on the 6th of October, 1846. His father's ancestors came from Germany and settled in Massachusetts and Vermont before the Revolution; the mother's were Dutch-English.

His early school life, military and naval career, and college life, his inventive genius and later achievements are all well known. He was active in the introduction and invention of the air brake which has taken his name, and of train signal systems; while alternating current machinery, the turbine reduction gear, natural gas development and railway equipment, were all utilized by him to contribute to the advancement of the human race. Achievement and service had precedence over all else.

Chance had no place in his success. It has been due entirely to his foresight, courage, and technical skill.

Owing to his many achievements in mechanics, electricity, steam and gas, his name was known the world over, and he had many honorable distinctions conferred upon him for his achievements and in recognition of the services he rendered the various branches of engineering. His alma mater, Union College of Schenectady, conferred upon him the degree of doctor of philosophy. He was decorated with the order of the Legion of Honor, with the order of the Royal Crown of Italy, with the order of Leopold of Belgium. He was the second recipient of the John Fritz medal. He received the degree of doctor of engineering from the Koenigliche Technische Hochschule of Berlin, Germany. He was an honorary member of the American Society of Mechanical Engineers, of which body he was also president in 1910. He was one of the two honorary members of the American Society for the Advancement of Science. He was an honorary member of the National Electric Light Association of America. He was awarded the Scott premium and medal by the Franklin Institute of the State of Pennsylvania. He received the Edison gold medal for meritorious achievements in the alternating current system of electrical distribution. He received the Grashof gold medal from the Society of German Engineers in Germany, which acknowledged him the greatest American engineer.

Mr. Westinghouse was connected with a large number of industries at home and abroad, many of which bore his name. He was president and director of the Westinghouse Air Brake Company, Westinghouse Machine Company, Nernst Lamp Company, The Union Switch & Signal Company, Societe Anonyme Westinghouse, Paris; Cooper Hewitt Electric Company, Pittsburgh Meter Company, Societe Italiene Westinghouse, Italy; The East Pittsburgh Improvement Company, The Westinghouse Brake Company, Ltd., London; Westinghouse, Cooper, Hewitt Company, London; Westinghouse Friction Draft Gear Company, Westinghouse Metal Filament Lamp Company, Ltd., London.

He was also chairman of the board of directors of the Westinghouse Electric Company, Ltd., London, and director Westinghouse Electric & Manufacturing Company, The Traction & Power Securities Company, Westinghouse Metallfaden Gluhlampenfabrik, Vienna.

The Westinghouse Companies employ 50,000 men on whom 150,000 persons are dependent. The total capitalization of all the companies is $200,000,000.

Mr. Westinghouse was married August 8, 1867, at Brooklyn, N. Y., to Marguerite Franklin Walker. They had one son, George, who is a graduate of Yale, and was recently married to the Honorable Evelyn Violet Brocklebank. His wife and son survive him.

MEETING NOTICES.

Seattle Jovian League.

The Seattle Jovians were entertained at dinner Friday, March 13th, at the Butler Hotel by a committee consisting of Messrs. Byrne and Heine of the North Coast Electric Company and Steven Mason. This committee arranged a very enjoyable program and the entertainment presented included a wrestling match, which was contested to a draw by a member representing a jobber and one of the contractors, a four-round boxing contest, by two aspiring light weights, and an elaborate musical program.

Oregon Society, Engineers.

On Thursday evening, March 12th in room "A" of the Public Library Building, Portland, Oregon, Prof.O. F. Stafford of the "Department of Chemistry of the University of Oregon," spoke on the "Fixation of Atmospheric Nitrogen" and illustrated his lecture by lantern slides. This subject proved of great interest to all those present, and should be of interest to all the citizens of Oregon, as well in view of the possible development of electric power at Celilo Falls, on the Columbia River, in such quantities that it may be economically used for this purpose.

Oregon Electrical Contractors' Association.

The regular meeting of the Oregon Electrical Contractors' Association was held at the Portland Commercial Club.

E. F. Dunlap, city inspector of electricity, Portland, Oregon, gave a short talk in which he endeavored to explain to the satisfaction of the contractors the reason why the new electrical ordinance for the city was not ready for final passage. A committee, of which Mr. Dunlap is chairman, has been working on this ordinance for over a year. As the old ordinance is badly in need of revision and the contractors have so long been waiting patiently for the new ordinance they are now investigating the delay, with the idea of getting immediate action.

San Francisco Electrical Development and Jovian League.

At the Hof Brau on Tuesday, March 17, 1914, a large and enthusiastic gathering of the League enjoyed one of the best papers ever presented before that body. The speaker of the day was Wm. Woodhead, president of the Associated Advertising Clubs of America, who spoke on Co-operation in Publicity.

Mr. Woodhead traced the growth of advertising and made many pertinent and interesting remarks regarding its value and efficient utilization. In concluding he directed the attention of members of the electrical industry to the necessity of not only enjoying the benefits to be derived from co-operative effort in advertising, but for each to tie up with it; to gather the cumulative effect and to follow it up with individual effort as "it could not win alone." W. F. Neiman occupied the chair.

The Jovian Electrical League of Southern California.

The weekly luncheon resolved itself into a physical culture class, as, we understand, has been the case with many other Jovian Clubs throughout the country, who have had the good fortune to be addressed by the health lecturer, W. Earl Flynn. The title of Mr. Flynn's address was "High Voltage in Health," and while he held the attention of his audience at high tension, he gave to them many valuable hints on how to remain healthy and gain strength by right living, thinking and eating. Mr. Flynn, who, it is stated, is the highest priced lecturer on any American platform, was introduced in gingery fashion by his staunch supporter and pupil, the Rev. Dr. J. Whitcomb Brougher. Before the close of his address, Mr. Flynn had all the Jovians on their feet, repeating various breathing and muscle building exercises, but in each instance Mr. Flynn, the oldest of them all in years only, surpassed his 100 embryo students by his remarkable feats of endurance. The meeting, which was as interesting and instructive as it was unique, was presided over by E. P. Lewis.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

A joint convention of the above bodies will be held at Spokane, Washington, during September, 1914. It will be the occasion of the Pacific Coast A. I. E. E. Convention and of the seventh annual convention of N. E. L. & P. A.

In view of the joint arrangement and the forceful program which has been prepared, a record attendance is anticipated.

During each morning, parallel sessions will be held—management and public policy papers being considered by the commercial men, and technical topics by the engineers.

Joint sessions will be held during each afternoon so that where both these interests merge, none interested need be absent on account of the presentation of other papers

The necessity for giving the proper amount of time to each subject and of allowing full discussion, the avoidance of a too high convention business peak, and the need for specialization, make such arrangements eminently desirable and should be a marked feature in adding to the success of the convention.

Arrangements are being perfected to hold a monster Jovian rejuvenation at that time at which some of the national officers expect to participate.

In connection with this convention the following committee has been appointed by President Mailloux of the American Institute of Electrical Engineers to in general make all necessary local arrangements in connection with the A. I. E. E. side of the affair:

D. L. Huntington, Chairman, Spokane, Wash.
John B. Fisken, Vice-Chairman, Spokane, Wash.
H. B. Peirce, Secretary, Spokane, Wash.
C. S. MacCalla, Spokane, Wash.
H. A. Shearer, Spokane, Wash.
J. W. Hungate, Spokane, Wash.
S. E. Gates, Spokane, Wash.
E. R. Northmore, Los Angeles, Cal.
C. G. Pyle, Los Angeles, Cal.
G. R. Murphy, San Francisco, Cal.
A. H. Halloran, San Francisco, Cal.
G. P. Nock, Portland, Ore.
R. F. Monges, Portland, Ore.
S. C. Lindsay, Seattle, Wash.
A. A. Miller, Seattle, Wash.
E. M. Breed, Vancouver, B. C.
F. D. Nims, Vancouver, B. C.
Max Hebgen, Butte, Mont.

An excellent entertainment program is being arranged by the officials of the Washington Water Power Company and visitors are assured that there will not be a dull moment during the time the convention is in progress.

Spokane, Washington, September, 1914.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS.

California Section.

C. W. Mitchell, president. W. G. Pennycook, vice-pres.
John W. Carrell, sec-treas.

Address of secretary, 55 Fulton street, San Francisco.

The purpose of this organization is to standardize the common practice in electrical construction with the National Code as the general standard.

Questions pertaining to electrical construction will be answered in these columns but only from the point of view of the Code. This is a voluntary organization and the answers published under this heading must not be construed as authoritative, or binding. No attempt will be made to correllate the answer from the several Inspection Districts as an occasional difference of opinion will tend to induce further study on subjects. All questions will be passed upon by an executive committee.

Address all communications to the secretary.

The California Section of the National Association of Electrical Inspectors, held its second meeting at the office of the Board of Fire Underwriters of the Pacific Coast, Merchants' Exchange Building, Saturday afternoon, March 14th.

The members present were: C. W. Mitchell, Underwriters' Inspection Bureau; W. G. Pennycook, O. K. Jones, E. F. Henzel, John W. Carroll, Arthur Kempston, Charles Parker, S. G. Curtis, of San Francisco; B. C. Hill, G. M. Hodgkins, H. M. White, F. A. Ellison, of Oakland; W. E. Brothers, Berkeley; W. A. Spencer, San Jose; Jas. I. Dixon, Santa Clara; Fire Chief J. A. Brophy, Vallejo, and W. R. Carpenter, Modesto.

Communications from other cities were received endorsing the new Section and requesting membership application blanks.

By the Secretary.

Ah, my masters, this was a meeting! Not a mutual admiration society, but an organization of fighters with a common enemy in front, and a land of harmonious electrical construction on the horizon. King Chaos was defied, indicted, and in the not distant future will be burned at the stake to make a common holiday for the electrical fraternity. The chief topic of the meeting was Procedure. The heads of the several Inspection Bureaus represented recited in detail the nature of the ordinance under which they operate, the general standard adopted the method of filing and of recording inspections and the manner of enforcing the law. While the method of procedure in the several localities is somewhat diversified it is manifest that the salient points are very much the same and that a standardization of the common practice is entirely feasible. The entire membership of the section is optimistic on this point.

Of more than passing interest was the relating by Fire Chief Brophy of Vallejo and by others of incidents where fires have been caused by defective wiring.

The next meeting of the section will be held at 2 o'clock Saturday, March 28th, at Room 19, Merchants' Exchange Building, San Francisco.

Utah Electric Club.

The regular weekly luncheon was held at the Commercial Club Thursday, March 12th. Leo Brandenberger presided.

W. S. Cozad, president of the Colorado Electric Club, was present as a guest and extended the greetings of his club to the Utah Electric Club. He told how the Colorado Electric Club had grown so rapidly as to make it necessary to absorb the Traffic Club, which had formerly been the principal commercial club of the city.

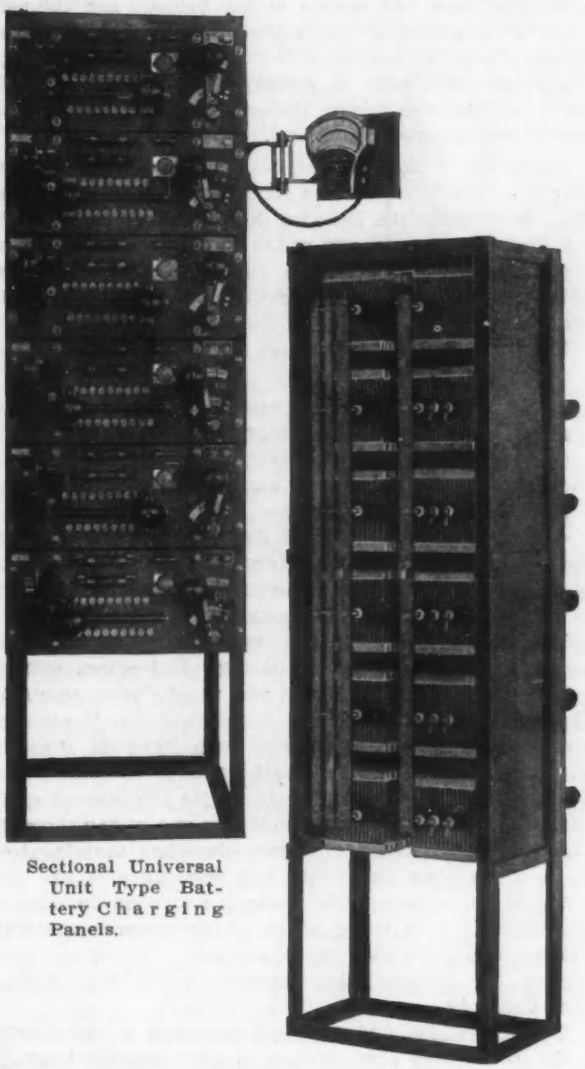
J. F. Greenwald, special representative of the Mountain States Telephone & Telegraph Company, recently transferred here from Helena, Montana, followed with a few well chosen remarks.

John D. Spencer, general agent of the New York Life Insurance Company, who has conducted a regular class in "Salesmanship" at the Y. M. C. A. for the past five years, delivered a talk on this subject as the regular speaker of the day.

INDUSTRIAL

SECTIONAL BOOK CASE IDEA BATTERY CHARGING PANELS.

Owing to the steady increase in the use of electric passenger and commercial vehicles, charging stations are called upon at frequent intervals to increase the capacity of the charging equipment. Because of this it is advantageous to install equipment to which additions can be made easily and economically. The new Universal unit type charging panels made by The Cutler-Hammer Manufacturing Company of Milwaukee are made up of self-contained rheostats assembled in frames in much the same way that the present day efficient sectional filing cabinets or book cases are assembled, each standard panel accommodating any number of sections up to six. Any number of panels can be assembled side by side according to the space available and regardless of the fact that these may be installed at different times, the complete equipment will have the appearance as if installed at one time. These panels are for use on both two-wire and three-wire circuits.



Sectional Universal Unit Type Battery Charging Panels.

Rear View.

Each charging section is a unit in itself and consists of a slate front 24 in. by 10 in. carrying the rheostat contacts and sliding brush; a low current circuit-breaker, at left side; an instrument switch, at right; a pilot lamp and grid type resistance mounted on the back. On the upper left hand corner of the front a card holder is provided in which a card bearing the designation of the charging circuit can be inserted. Each section is supported by bolts to the frame and after disconnecting from the bus-bar can be readily removed if these bolts are taken out. For repairs or inspection a section can be taken out about as easily as a drawer or section from a filing cabinet.

The low current circuit-breaker mounted at the left of the front is interlocked with the rheostat so that it cannot be closed except when the sliding brush is moved to the position of "all resistance in." It can then be closed and a small magnet which is in series with the charging circuit holds it in this position unless the charging voltage falls to a value less than the battery voltage or in case the service fuses should be blown. It thus acts as a line switch.

The instrument switch is a three-position switch having "Open," "Closed" and "Reading" positions. When in the "Open" position the circuit to the battery is broken; moving to the "Closed" position completes this circuit—and when in the "Reading" position the meter, which may be mounted on the top section or on a swinging bracket, is connected in the battery circuit indicating the voltage of the battery. If the low current circuit-breaker is closed, the current is also indicated on the ammeter scale of the instrument.

The duplex instrument which is furnished combines ammeter and voltmeter and a single instrument can be used for several panels, if desired. The scales are five inches long and thus allow close readings.

A discharge rheostat is mounted on the top section of some panels to operate in conjunction with the charging rheostat section directly below it.

As can be seen by referring to the illustration everything is within easy reach and no operating rods are required. The rheostat being arranged adjacent to the controlling switch, eliminating the chance for error in operating the wrong rheostat. Meter readings are made without opening the charging circuit. The voltage and current may be read at any time by moving the corresponding instrument switch to the "reading" position. It is not intended that more than one of these switches be operated at one time but should anyone through ignorance move two at once, no damage will result, as by a special arrangement of the voltmeter connections, the cross currents resulting are made ineffective. When it is desired to stop the charge, the circuit is opened by moving the instrument switch to the "open" point, the arc formed on opening the circuit being taken on the auxiliary contacts which are provided with magnetic blowout. This opening of the circuit de-energizes the low current circuit breaker which opens, disconnecting the battery from both sides of the line. When the plug is removed from the vehicle, the charging cable is entirely dead.

TRADE NOTES.

Bay Cities Engineering Company, Humboldt Bank Building, San Francisco, has been awarded the contract to furnish and install the overhead equipment of the Union street line, at a cost of $4700.

The Eppstein Electric Company, San Francisco, has been absorbed by the California Electric Construction Company which will conduct this new business from 664 Mission street, the present location of the former concern being closed out.

The West Coast Engineering Company has obtained the contract for the electrical installation in the Crystal Ice & Cold Storage Company's plant, Portland, Ore. This plant is being changed over from steam to electrical drive throughout.

NEWS NOTES

FINANCIAL.

TACOMA, WASH.—For the first full year it has been in operation, the Nisqually power plant of Tacoma shows a profit of $290,000 to the city, according to the report of the state bureau of inspection and supervision of public offices, made public recently. The plant was built at a ost of about $2,000,000 and was put in operation a year and four months ago.

INCORPORATIONS.

BELLINGHAM, WASH.—Articles of incorporation of the Blaine Electric Company have been filed. The capital is $250,000 and the purpose of the company is to build an electric line between Lynden and Blaine.

KLAMATH FALLS, ORE.—Articles of incoporation of the Keno Power Company, capitalized at $250,000 have been filed by J. W., B. E. and G. G. Kerns, and will operate in Klamath Falls if a franchise is granted the company by the city council.

ILLUMINATION.

GOLCONDA, NEV.—The commissioners have granted the application of J. B. Fayant for a franchise to construct and operate an electric light and power plant in this town.

LOS ANGELES, CAL.—The Long Beach Gas Company has made application to the board of supervisors of Orange county for a franchise to lay pipes and supply gas in the town of Seal Beach.

SAN DIEGO, CAL.—The city council has commissioned the installation of 50 additional arc lights to be installed in the residence sections of the city. Work will begin in the near future.

EVERETT, WASH.—Bids will be received until March 24th for the furnishing of lights for the streets and public buildings of this city for the period of either three or five years commencing April 1, 1914.

LOS ANGELES, CAL.—Resolutions urging the council to take steps to acquire a gas as well as an electrical distributing system have been passed by the N. E. W. Commercial-Improvement Association,

PROVO, UTAH.—The Utah Power & Light Company has entered into a contract with Provo City providing for the supply of fifty 6.6 ampere luminous arc lamps for street lighting purposes at $5.50 each per month.

ORANGE, CAL.—Sealed bids will be received up to April 8th by the board of supervisors of Orange county for a franchise granting right to lay, operate and maintain gas distribution system under and along public streets in or near Bay City, Cal.

SAN FRANCISCO, CAL.—An ordinance was passed by the city council prohibiting the placing of advertising signs on telegraph, telephone or electric light poles, lamp posts or upon any public sidewalk or roadway, and excepting street and hospital signs.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company has applied for an electric lighting franchise covering a district north of this city, and hearing of the petition is set for March 30th. The city of Seattle has filed its application for an electric lighting franchise covering a district north of the city of Seattle, and a hearing was also set for March 30th.

MOUNT PLEASANT, UTAH.—Mr. A. Lundberg has just completed and placed in operation an electric generating station for the purpose of supplying energy to this town. The plant derives its water from Pleasant Creek through approximately 900 ft. of pipe, using 16, 14 and 12 in. size carrying the water to a Pelton type water wheel which drives a 30 kw. generator. Mr. Lunberg plans to supply, in addition to his own requirements, those of the merchants located in the business part of the city.

TRANSMISSION.

LOS ANGELES, CAL.—Electricity for the Coachella vallew will be available within the near future if the plans of W. F. Holt, who has charge of the project, are completed according to schedule. The distribution system will furnish electricity to every portion of the Coachella valley, the rights of way for which have practically been secured. Mr. Holt was in Los Angeles during the past week negotiating for a right of way for the power line.

DREWSEY, ORE.—It has been announced that John E. Johnson & Sons Construction Engineers, who have been employed in building the Drewsey Reclamation Company ditch have filed on a power site above the Ott sawmill and contemplate the construction of a power plant capable of generating over 4000 h. p. Electric current will be carried to a number of towns in reach. But the main power will go to Harney, where it will be used to pump water from wells for irrigation.

OREGON CITY, ORE.—An electric system to include the towns of Needy, Liberal, Macksburg, Molalla and Wilhoit operated with power from a $25,000 plant on the Molalla River is the plan of M. J. Lee and his associates. Mr. Lee will petition the court for a franchise to construct pole lines on the county roads through that district. Machinery for the power plant through that district. The work of building will be under way within a short time, and it is believed that the system will be in operation in a few months.

RENO, NEV.—Ground has been broken at the Sparks shops for the erection of an electric plant which will cost in the neighborhood of $40,000 and which, when completed, will furnish sufficient current to operate the block signal system of the Salt Lake division from Imlay to Blue Canyon. The building will be 60x40 ft. and will be equipped with the latest modern machinery. With the present system of using batteries, the difficulty of any one of the thousands in use becoming defective, thereby disabling the signal system, is to be done away with and power houses are being erected at two other points along the division to meet the requirements. It is being added to the power house which furnishes the electricity for the shops and offices of the company, the current being supplied by the Reno Light & Power Company.

LOS ANGELES, CAL.—Long litigation is indicated following the decision of city officials to start condemnation proceedings of the power companies properties. It is generally believed that the Southern California Edison Company's system will be the first selected for proceedings. This company has systems in sixty towns in five counties in Southern California. If its property can be taken by the city of Los Angeles it can be acquired in the same manner by any or all the other cities and towns supplied by it, and the company's entire $30,000,000 investment would be affected. As a result, a legal war is inevitable, especially in view of the fact that the city can not readily be separated from the main system. Officials of the Edison Company are stated to have said that it is probable that a suit to prevent condemnation and to challenge the right of the state railroad commission to condemn the system may be carried to the United States supreme court if the city persists in the plan now under consideration.

TRANSPORTATION.

LOS ANGELES, CAL.—Paul Shoup, of the Pacific Electric Railway, has announced definitely, that his company has no intention of extending its lines to San Diego as rumored.

ALAMAGORDO, N. M.—A difference of $26,500 in estimates of value of the right of way between the towns of Hope and Artesia is holding up the conclusion of negotiations for an electric railroad between Cloudcroft and Artesia, is the statement made by J. C. Jones, one of the promoters.

PORTLAND, ORE.—By a vote of four to one the city commission granted a franchise to the Portland Railway, Light & Power Company for a crosstown street car line on the East Side. The franchise provides for the completion of the line within one year and runs for twenty-five years.

LOS ANGELES, CAL.—An agreement has been reached between the city and the Pacific Electric Railway on the construction of the proposed elevated tracks from rear of Sixth street station to San Pedro street. As a result, early action by the board of public utilities and the council in granting the franchise for the elevated tracks is promised.

SAN FRANCISCO, CAL.—Bids for furnishing concrete trolley poles for the Van Ness avenue line of the Municipal Railway have been received by the board of public works, the lowest of the four proposals being filed by H. S. Tittle. The lowest bid for furnishing underground conduit materials for the Municipal road was presented by Pierson, Roeding & Company. The bids have been taken under advisement.

SAN DIEGO, CAL.—The San Diego Railway Company plans to build a loop line by way of B street, Third, F and Twelfth streets, to handle the exposition crowds, and to extend the F street line as far as India street, if the franchise is granted by the city council. Permission to double-track F street will be asked, and to eliminate goose neck curves at Fourth and F streets and at other places where used by the Los Angeles & San Diego Beach Railway in operating downtown cars.

VANCOUVER, B. C.—Disclosure of the fact that five parties of engineers are in the field surveying routes for extensions north and south and branches east and west in connection with the proposed line for the Calgary and Fernie railway line, taken in conjunction with other moves which have lately become known, leads to the belief that one of the big American roads, the Great Northern or the Milwaukee, intends to invade the Canadian Northwest and find a new route to the Pacific Coast.

SAN FRANCISCO, CAL.—The price to be paid for the Union street railway by the city to the Presidio & Ferries Railroad Company, has been fixed at $312,322 by City Engineer O'Shaughnessy and the company's representative, T. C. Mullin. The company received $50,000 of the amount when the agreement to purchase was made, leaving $262,322 due, with an additional allowance of $3483 for interest at 5 per cent for 97 days from December 10, 1913, when the road was taken over for operation by the city.

SEATTLE, WASH.—A loan of $9000 from the general fund to be repaid at such a time as the revenues of the municipal car line are sufficient, is proposed by the city utilities committee to provide money for the establishing of service extending from Pine street to Thirteenth avenue West. The bill will go to the finance committee Friday with the recommendation of the city utilities committee that it do pass. Under present plans the line will be put in operation either the last week of March or the first week of April.

OAKLAND, CAL.—In furtherance of the plans for refinancing and developing the properties of the San Francisco-Oakland Terminal Railways, which have been evolved since the recent acquisition of the traction system of the east bay cities, a stockholders' meeting has been called to consider an increase of $15,000,000 in the bonded indebtedness of the railroad company. Notices have been issued to stockholders announcing a special meeting at the San Francisco-Oakland Terminal Railways offices in the Syndicate building, Oakland, at 10 a. m. April 7th.

SALT LAKE CITY, UTAH—.Announcement has been made at the offices of the Salt Lake & Utah Railroad Company that March 23d has been set for the inauguration of services of the Orem interurban electric line running south from Salt Lake City to Provo, a distance of about forty-five miles. The service to begin on that date will be by gasoline motor car, pending the completion of the installation of the electrical equipment, which will be on or before June 1st. Special celebrations have been planned in the various cities and villages reached by this line.

OAKLAND, CAL.—The San Francisco and Oakland Terminal Railways has made known its plan to establish its permanent office building at Twenty-second and Grove streets. The present depot is to be moved to some convenient spot near by. The ground will then be cleared and work started on the new structure immediately. The building will be a modern 3-story affair, and the entire management of the Key Route and the Oakland service lines will be housed there. The present offices are in the Syndicate building. It is announced that part of the ground floor will be devoted to a station for Key Route passengers.

SAN FRANCISCO, CAL.—After hearing protests from property owners who objected to the proposed extension of the municipal railroad on Second avenue, between Geary and California streets, and also a delegation who were in favor of the line, the board decided Second avenue the proper street for the extension, and so voted. A bill was passed to print directing the board of public works to prepare plans, specifications and contracts, and advertise for bids for furnishing and delivering the necessary material therefore, and constructing the extensions of the municipal street railway system, for which funds were provided in the bond issue authorized August 26, 1913.

TELEPHONE AND TELEGRAPH.

FLORENCE, ARIZ.—The Mountain States Telephone & Telegraph Company, P. C. Gettins, district manager, has informed the Florence Commercial Club of intention to rebuild its plant here within a few months.

LAS VEGAS, NEV.—Mr. Thomas, manager of the Nevada line of the Utah-Idaho-Nevada Telephone Company, states that efforts will be made at once to extend the line between Caliente and Delamar to Alamo and other points in Pahranagat valley.

LOS ANGELES, CAL.—The Pacific Telephone & Telegraph Company will spend $18,700 in immediate future on miscellaneous improvements to its telephone system in this city, according to C. F. Mason, division superintendent. A large amount of cable is to be placed.

OAKLAND, CAL.—Officials of the Pacific Telephone & Telegraph Company have informed the city officials that the compromise tangle is no nearer solution now than it was a week ago, when it was learned that the directors of the existing concern and those of the defunct Home Company were in disagreement. As a result the compromise matter is still hanging fire in the courts. The directors of the two concerns are arguing over the merits and demerits of the compromise offer made the city by officials of the old Home Company. The Pacific officials say that the Home directors were too free with their offer of concessions. The compromise offer was made to do away with the city's suit against the Home company for $100,000 for selling its franchise to the effect that Pacific Company will pay the city 2 per cent of its gross returns if the suit is dropped and if the city will give the existing concern the additional years granted in the Home franchise.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page opposite

A-1 American Ever-Ready Co.
Los Angeles; 755 Folsom Street, San Francisco; Seattle.

B-1 Benjamin Electric Manufacturing Co. 11
Rialto Building, San Francisco.

B-2 Berkeley Electric Cooker Co.
1932 Center Street, Berkeley.

B-3 Blake Signal and Manufacturing Co.
680 Howard Street, San Francisco.

B-5 Bridgeport Brass Co. 4
(See Pierson, Roeding & Co.)

C-1 Century Electric Co. 4
614 So. Grand Ave., Los Angeles; Salt Lake City; 56 Natoma Street, San Francisco; Seattle; Spokane.

C-2 Crocker-Wheeler Co. 12
Title Insurance Bldg., Los Angeles; Salt Lake City; First National Bank Bldg., San Francisco; Seattle.

C-3 Cutler-Hammer Manufacturing Co.
579 Howard Street, San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-1 D. & W. Fuse Co.
(All Jobbers.)

D-2 Dearborn Drug and Chemical Works 12
355 East Second Street, Los Angeles; 301 Front Street, San Francisco.

E-1 Edison Lamp Works of General Electric Co.
(See General Electric Company.)

E-2 Edison Storage Battery Supply Co. 12
441 Golden Gate Avenue, San Francisco.

E-3 Electric Agencies Co.
247 Minna Street, San Francisco.

E-4 Electric Storage Battery Co.
Pacific Electric Building, Los Angeles; Spalding Building, Portland; 118 New Montgomery Street, San Francisco; Colman Building, Seattle; Pacific Building, Vancouver.

F-1 Fairbanks, Morse & Co.
Los Angeles; Portland; 651 Mission Street, San Francisco; Seattle; Spokane.

F-2 Fort Wayne Electric Works of G. E. Co.
Rialto Building, San Francisco; Colman Building, Seattle.

G-1 General Electric Co. 13-14-15
124 W. Fourth Street, Los Angeles; Worcester Building, Portland; Rialto Building, San Francisco; Colman Building, Seattle; Paulsen Building, Spokane.

H-1 Habirshaw Wire Co.
(See Western Electric Company.)

H-2 Hemingray Glass Co. 5
330 So. L. A. Street, Los Angeles; 345 Oak Street, Portland; 807 Mission Street, San Francisco.

H-3 Hoagland-Hulse Electric Co.
1707 Naud Street, Los Angeles.

H-4 Hunt, Mirk & Co. 6
141 Second Street, San Francisco.

I-1 Indiana Rubber and Insulated Wire Co.
807 Mission Street, San Francisco.

K-1 Kellogg Switchboard and Supply Co.
Aronson Building, San Francisco.

K-2 Keystone Boiler Works.
201 Folsom Street, San Francisco

K-3 Klein & Sons, Mathias. 5
579 Howard Street, San Francisco.

K-4 K-P-F Electric Co.
37 Stevenson Street, San Francisco.

L-1 Leahy Manufacturing Co.
Eighth and Alameda Streets, Los Angeles.

L-2 Locke Insulator Manufacturing Co. 3
(See Pierson, Roeding & Co.)

M-1 Mannesmannrohren-Werke
Rialto Building, San Francisco.

M-2 McGlauflin Manufacturing Co.
Sunnyvale.

M-3 Moore & Co., Charles C.
Van Nuys Building, Los Angeles; Spalding Building, Portland; Kearns Building, Salt Lake City; 40 First Street, San Francisco; Mutual Life Building, Seattle; Santa Rita Hotel Building, Tucson.

M-4 Morse Chain Co.
Monadnock Bldg., San Francisco.

N-1 Nason & Co., R. N.
151 Potrero Avenue, San Francisco.

N-2 National Conduit & Cable Co., The
Trust and Savings Building, Los Angeles; Rialto Building, San Francisco.

N-3 National Lamp Works of G. E. Co.
(All Jobbers.)

N-4 New York Insulated Wire Co.
629 Howard Street, San Francisco.

N-5 Norris Co., L. A.
Monadnock Building, San Francisco.

O-1 Okonite Co. 16
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co. 4
80 Tehama Street, San Francisco.

P-2 Pacific States Electric Co. 2
526 So. L. A. Street, Los Angeles; 90 Seventh Street, Portland; 526 Thirteenth Street, Oakland; 575 Mission Street, San Francisco; 307 First Ave., So., Seattle.

P-3 Parker Boiler Co.
201 Folsom Street, San Francisco.

P-4 Pelton Water Wheel Co. 5
2219 Harrison Street, San Francisco.

P-5 Pierson, Roeding & Co. 3-5-12
Pacific Electric Building, Los Angeles; Spalding Building, Portland; Rialto Building, San Francisco; Colman Building, Seattle; Pacific Building, Vancouver.

P-7 Pittsburg Piping & Equipment Co. 16
Monadnock Building, San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The
211 J Street, Sacramento; 356 Market Street, San Francisco.

S-2 Simonds Machinery Co.
12 Natoma Street, San Francisco.

S-3 Simplex Electric Heating Co. 16
612 Howard Street, San Francisco.

S-4 Southern Pacific Co. 4-12
Flood Building, San Francisco.

S-5 Sprague Electric Works of G. E. Co. 3
Rialto Building, San Francisco; Colman Building, Seattle.

S-6 Standard Underground Cable Co. 4
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland, Or.; Central Bldg., Seattle, Wash.

S-7 Staples & Pfeiffer.
102 Steuart Street, San Francisco.

T-1 Thomas & Co., R.
(See Western Electric Co.)

V-1 Van Emon Elevator Co.
56 Natoma Street, San Francisco.

W-1 Wagner Electric Manufacturing Co. 4
Rialto Building, San Francisco.

W-2 Western Electric Co.
119 East Seventh Street, Los Angeles; 507 Sixteenth Street, Oakland; 680 Folsom Street, San Francisco; 1518 First Avenue, So., Seattle.

W-3 Westinghouse-Church-Kerr Co.
Pacific Electric Building, Los Angeles; Pacific Building, San Francisco.

W-4 Westinghouse Electric and Manufacturing Co.
50-52 East Broadway, Butte; Van Nuys Building, Los Angeles; Couch Building, Portland; 212 So. W. Temple, Salt Lake City; 165 Second Street, San Francisco; Central Building, Seattle; Paulsen Building, Spokane.

W-5 Westinghouse Machine Co. 6
141 Second Street, San Francisco.

W-6 Westinghouse Lamp Co. 16
(See Westinghouse Electric and Manufacturing Co.)

W-7 Weston Electrical Instrument Co. 3
682 Mission Street, San Francisco.

W-8 Western Pipe & Steel Co.
444 Market Street, San Francisco; 1758 North Broadway, Los Angeles.